

**Total Maximum Daily Loads for Indicator Bacteria
in the Houston Metropolitan Area**

**Contract No. 582-6-70860
Work Order No. 582-6-70860-04**

Draft Quarterly Report No. 1

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY AND
U.S. ENVIRONMENTAL PROTECTION AGENCY

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CHAPTER 1

INTRODUCTION

1.1 PROBLEM STATEMENT

The Texas Commission on Environmental Quality (TCEQ) is responsible for administering provisions of the constitution and laws of the State of Texas to promote judicious use of and the protection of the quality of waters in the State. A major aspect of this responsibility is the continuous monitoring and assessment of water quality to evaluate compliance with state water quality standards that are established within Texas Water Code, §26.023 and Title 30 Texas Administrative Code, §§307.1-307.10. Texas Surface Water Quality Standards 30 TAC 307.4(d) specify that surface waters will not be toxic to aquatic life. Pursuant to the federal Clean Water Act §303(d), states must establish Total Maximum Daily Loads (TMDLs) for pollutants contributing to violations of water quality standards. The target water bodies in this project are on the Texas' Clean Water Act §303(d) List for frequency and magnitude of exceedances of fecal coliform and *E. coli*-based water quality criteria for contact recreation. The twenty-seven (27) impaired segments being addressed under this project are listed in Table 1.1 and their locations are shown in Figure 1.1.

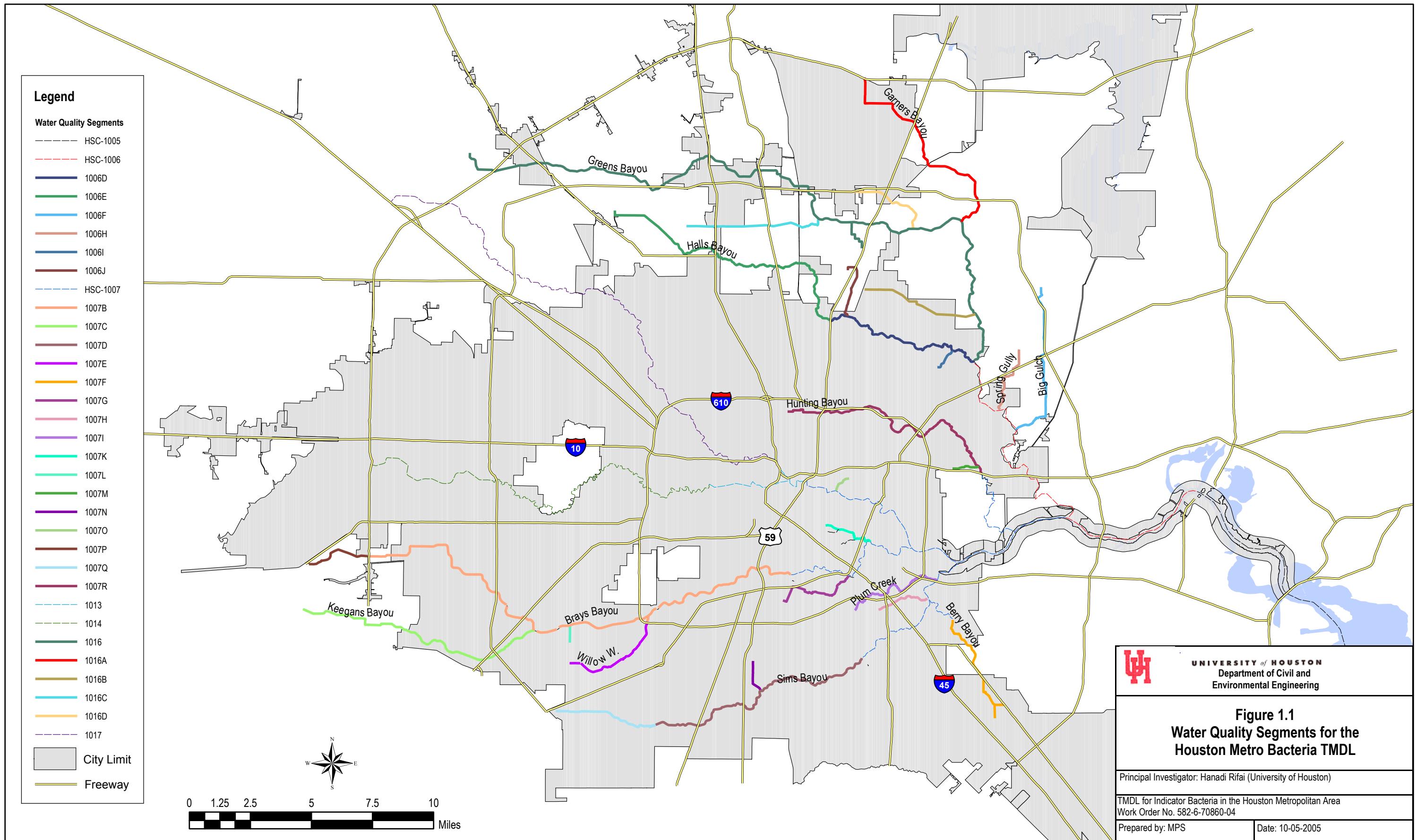


Table 1.1 TMDL Segments

Segment Number	Segment Name
1006D	Halls Bayou below US 59
1006E	Halls Bayou above US 59
1006F	Big Gulch Above Tidal
1006H	Spring Gully Above Tidal
1006I	Unnamed Tributary of Halls Bayou
1006J	Unnamed Tributary of Halls Bayou
1007B	Brays Bayou Above Tidal
1007C	Keegans Bayou above tidal
1007D	Sims Bayou Above Tidal
1007E	Willow Waterhole Bayou Above Tidal
1007F	Berry Bayou Above Tidal
1007G	Kuhlman Gully Above Tidal
1007H	Pine Gully Above Tidal
1007I	Plum Creek Above Tidal
1007K	Country Club Bayou
1007L	Unnamed Non-Tidal Tributary of Brays Bayou
1007M	Unnamed Non-Tidal Tributary of Hunting Bayou
1007N	Unnamed Non-Tidal Tributary of Sims Bayou
1007O	Unnamed Non-Tidal Tributary of Buffalo Bayou
1007P	Brays Bayou Above Tidal
1007Q	Sims Bayou Above Tidal
1007R	Hunting Bayou Above Tidal
1016	Greens Bayou Above Tidal
1016A	Garners Bayou
1016B	Unnamed Tributary of Greens Bayou
1016C	Unnamed Tributary of Greens Bayou
1016D	Unnamed Tributary of Greens Bayou

The overall objective of this project is to develop the TMDL allocation equation for the segments listed above. An important part of this objective is to determine the data analysis technique that will be used for determining and supporting the TMDL allocation equation. An extensive study of the Buffalo and Whiteoak watersheds has been conducted by UH for the development of the TMDL allocation equation for bacteria. The information and experience gained from the previous TMDL study is being used to expedite the development of the TMDL allocation.

There are three main tasks to be completed for WO4 (Contract No 582-6-70860):

1. Project administration;
2. Participation in stakeholder process; and
3. Determination of Project Strategy.

1.2 DESCRIPTION OF THE REPORT

This document constitutes the first quarterly report for Work Order No. 582-6-70860-04 (Contract No. 582-6-70860) of the Bacteria in the Houston Metropolitan Area TMDL Project and summarizes the activities undertaken by the University of Houston during the period September 28 to November 30, 2005.

This report reflects the progress made towards the following subtasks delineated in the Project Work Plan:

Subtask 3.1 - Review the Previous Project (Bacteria TMDL in Buffalo and Whiteoak Bayous) to determine what elements of the project can be used in the Houston Metropolitan project.

Subtask 3.2 - Determine what watershed/segments characteristics are necessary to be able to utilize the information and experience gained from the Previous Project.

Subtask 3.4 - Review all available information on the segments and watersheds listed above and identify data gaps and needs.

A summary of historical data pertinent to this study for the 27 TMDL segments is presented in Chapter 2. Chapter 2 also presents a list of data gaps and needs. Chapter 3 includes a proposed sampling plan for FY2006 to support TMDL development. Finally, a summary of activities as well as a list of activities to be conducted in the next quarter of the project is presented in Chapter 4.

CHAPTER 2

REVIEW OF HISTORICAL DATA

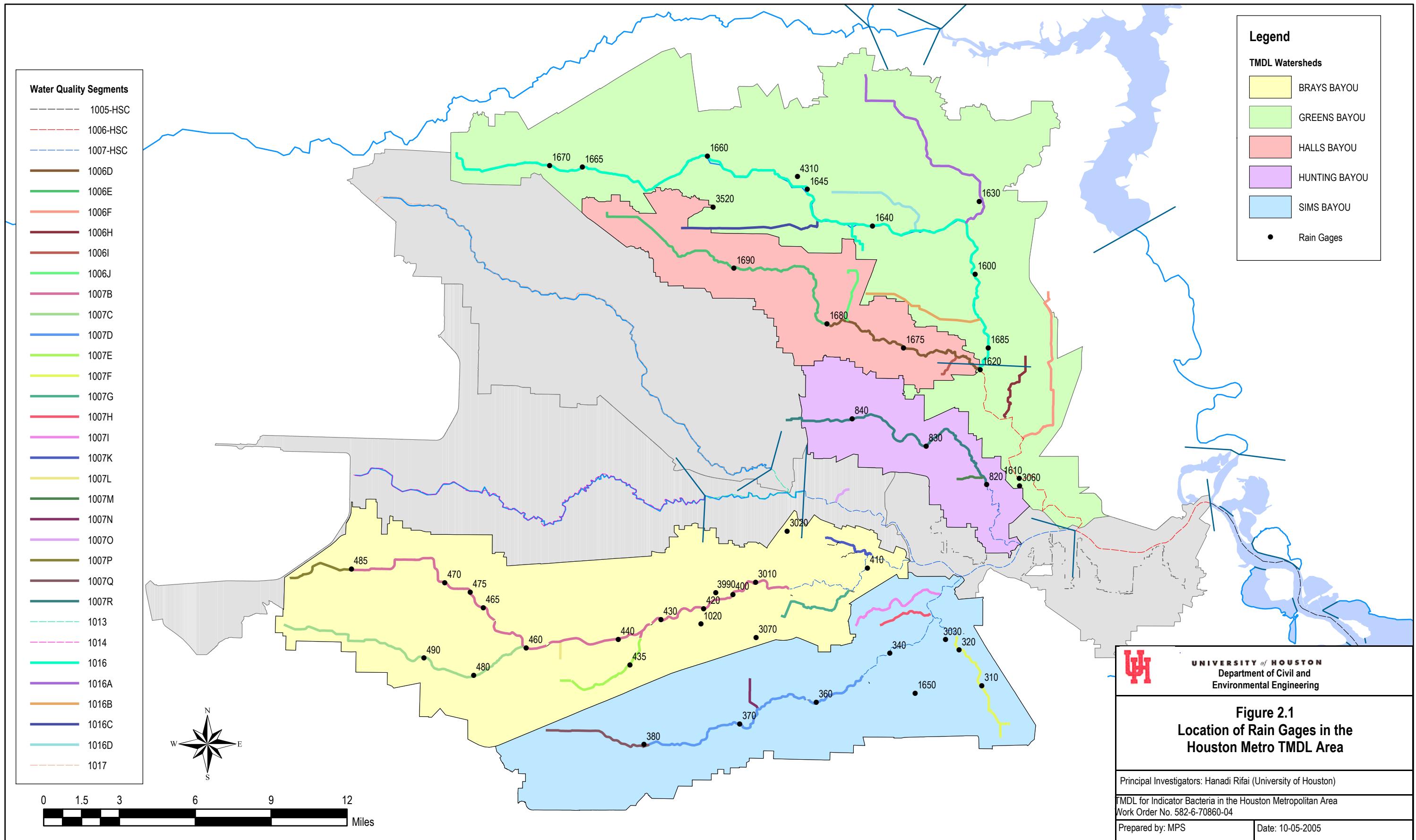
A compilation of historical rain, flow, TSS, fecal coliform, and *E. coli* data was conducted for the watersheds comprising this TMDL.

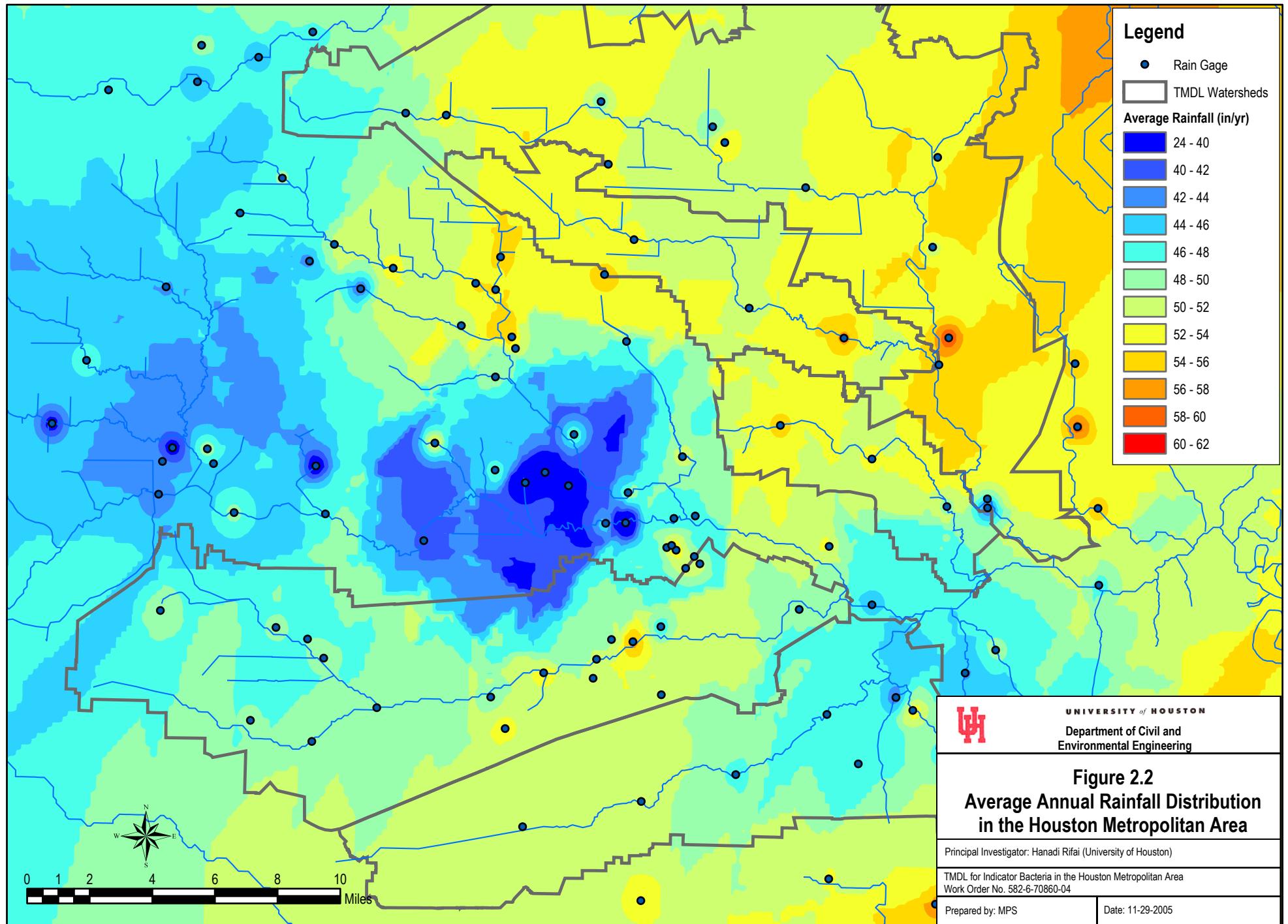
There are 45 Harris County Office of Emergency Management (HCOEM) rain gages in the watersheds included in the project (Figure 2.1). Average annual rainfall in the study area for the period 2000-2004 varied between 33 and 66 inches, with an average of 50 inches. Figure 2.2 illustrates the historical annual precipitation ranges for the entire Houston area obtained by kriging annual average data for all the existing HCOEM gages (including those outside the TMDL area).

Thirteen USGS flow gages are located in the study area (Figure 2.3), seven of which have relatively complete and current flow records as can be seen in Table 2.1.

Table 2.1 Summary of USGS Gages in the Project Area

USGS Gage ID	Site Name	Segment	Begin Period	End Period
8074800	Keegans Bayou at Roark Rd nr Houston, TX	1007C	9/1/1964	9/30/1981
8074810	Brays Bayou at Gessner Dr, Houston, TX	1007B	10/1/1989	9/30/2004
8075000	Brays Bayou at Houston, TX	1007B	6/1/1936	9/30/2004
8075400	Sims Bayou at Hiram Clarke St, Houston, TX	1007Q	9/1/1964	9/30/2004
8075500	Sims Bayou at Houston, TX	1007D	10/1/1952	9/1/2001
8075650	Berry Bayou at Forest Oaks St, Houston, TX	1007F	5/1/1964	9/30/2001
8075770	Hunting Bayou at IH 610, Houston, TX	1007R	5/1/1964	9/30/2004
8075780	Greens Bayou at Cutten Rd nr Houston, TX	1016	10/1/1997	9/30/2002
8075900	Greens Bayou near US Hwy 75 nr Houston, TX	1016	8/3/1965	9/30/1992
8076000	Greens Bayou nearr Houston, TX	1016	10/1/1952	9/30/2004
8076180	Garners Bayou near Humble, TX	1016A	2/25/1986	9/30/2004
8076500	Halls Bayou at Houston, TX	1006E	10/1/1952	9/30/2004
8076700	Greens Bayou at Ley Rd, Houston, TX	1016	12/2/1971	9/22/2003





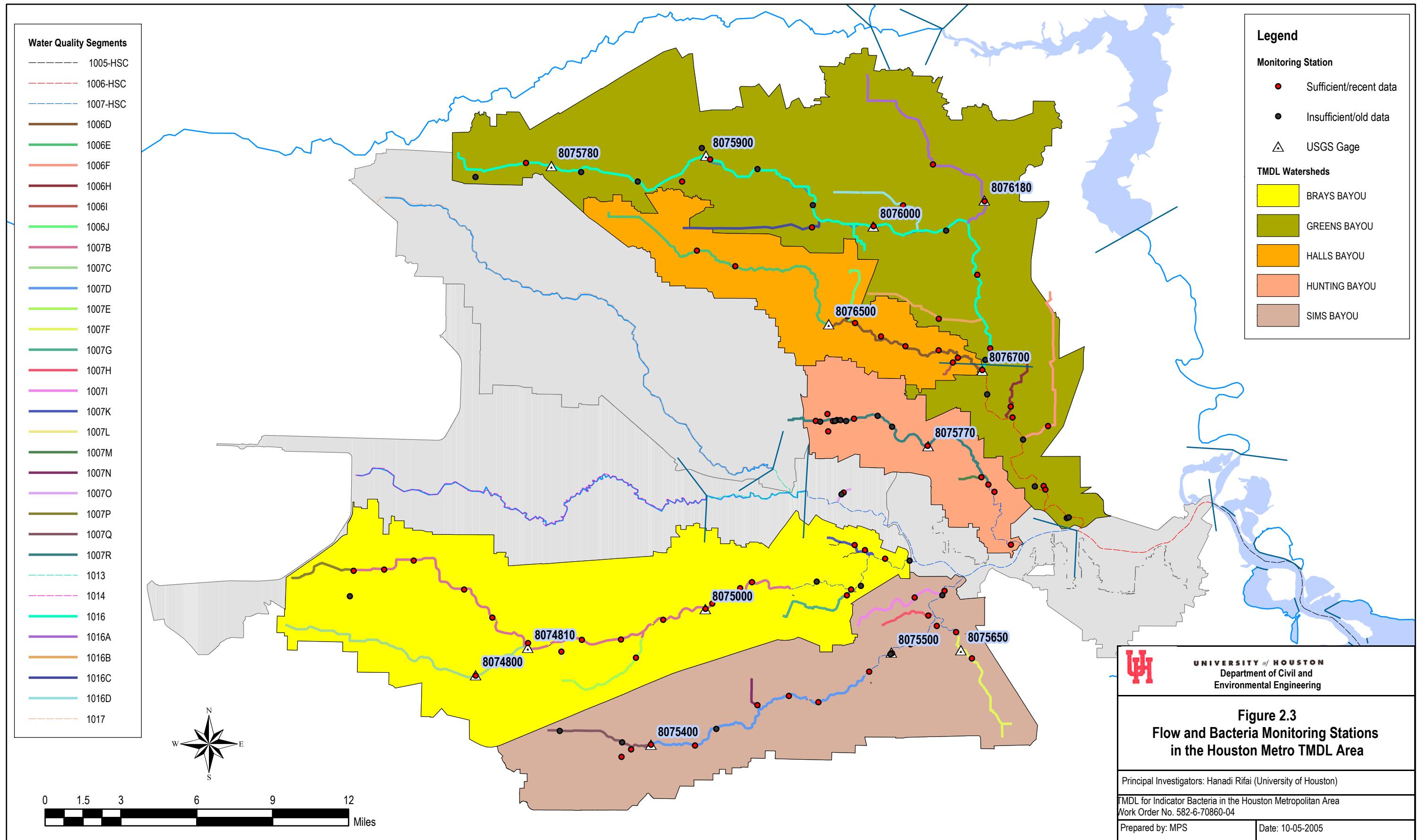


Figure 2.4 shows scatterplots of available flow data for the thirteen gages located in the Houston Metropolitan area. Figure 2.5 shows the cumulative flow frequency curves for these gages. For the gages with current data, the curve for the complete period of record and the curves for data up to 1990 and for the period 1991-2004 are shown. This was done to identify any changes in flow regimes due to rapid urbanization (1990's). It can be seen in Figure 2.5 that the flow regime for gages 8075400 (Sims at Hiram Clarke) and 8075770 (Hunting at IH 610) appears to be the same for the whole period. On the other hand, gages 8075000 (Brays at Houston), 8076000 (Greens near Houston), 8076180 (Garners at Humble), and 8076500 (Halls at Houston) present consistently higher flows for the period after 1990 compared to those measured prior to 1991. Finally, gage 8074810 (Brays at Gessner) shows a change in flow regime only for the higher flows (again flows measured after 1990 are higher than those measured prior to 1991).

Table 2.2 summarizes median flows using the entire record for the various USGS gages in the study area as well as the changes in median flows for the stations that presented changes in flow regime in the last 15 years as discussed above.

Table 2.2 Median Flows for USGS Gages in Study Area

USGS Gage	Segment	Median Flow (cfs)		
		All data	Prior to 1991	1991-2004
8074800	1007C	34	-	-
8074810	1007B	76	73	77
8075000	1007B	82	45	132
8075400	1007Q	12	12	11
8075500	1007D	38	-	-
8075650	1007F	5.6	-	-
8075770	1007R	7.4	7	9
8075780	1016	41	-	-
8075900	1016	13	-	-
8076000	1016	26	17	43
8076180	1016A	14	8.2	17
8076500	1006E	9.7	8.5	16
8076700	1016	700	-	-

Rows highlighted in green correspond to the gages for which the median flow was significantly higher for the period 1991-2004.

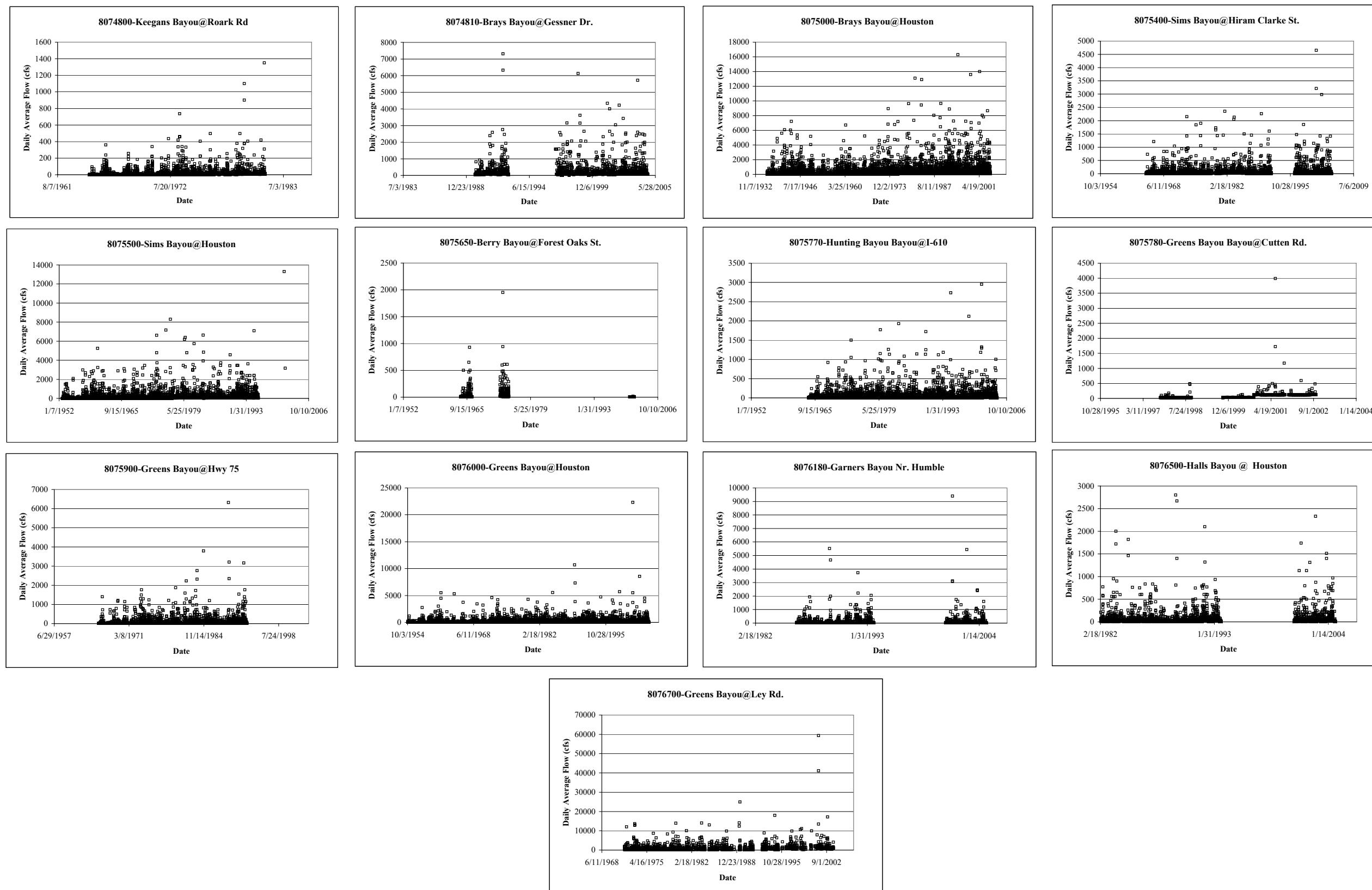


Figure 2.4 Flow Data for USGS Gages located in the Houston Metro TMDL Area

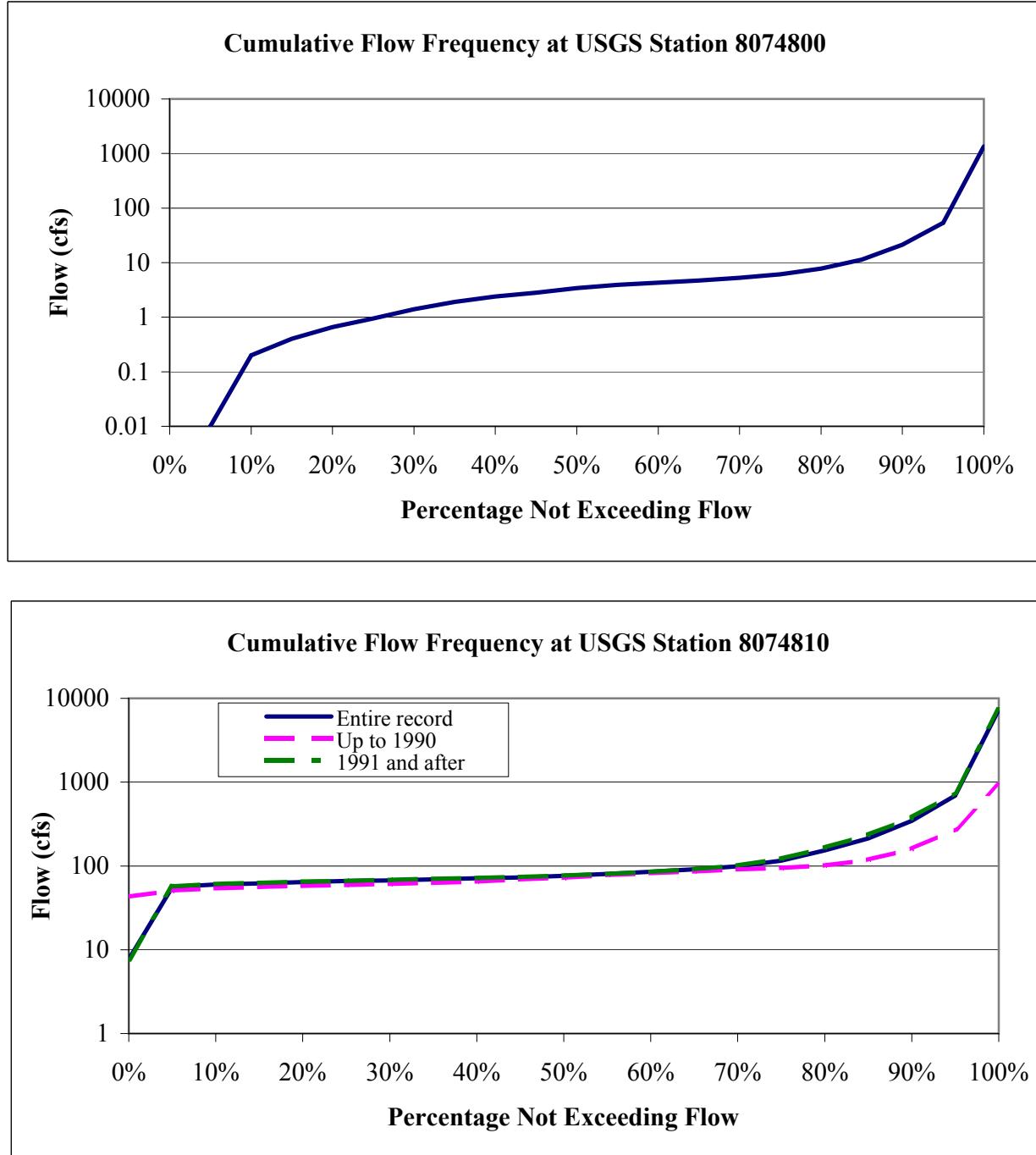
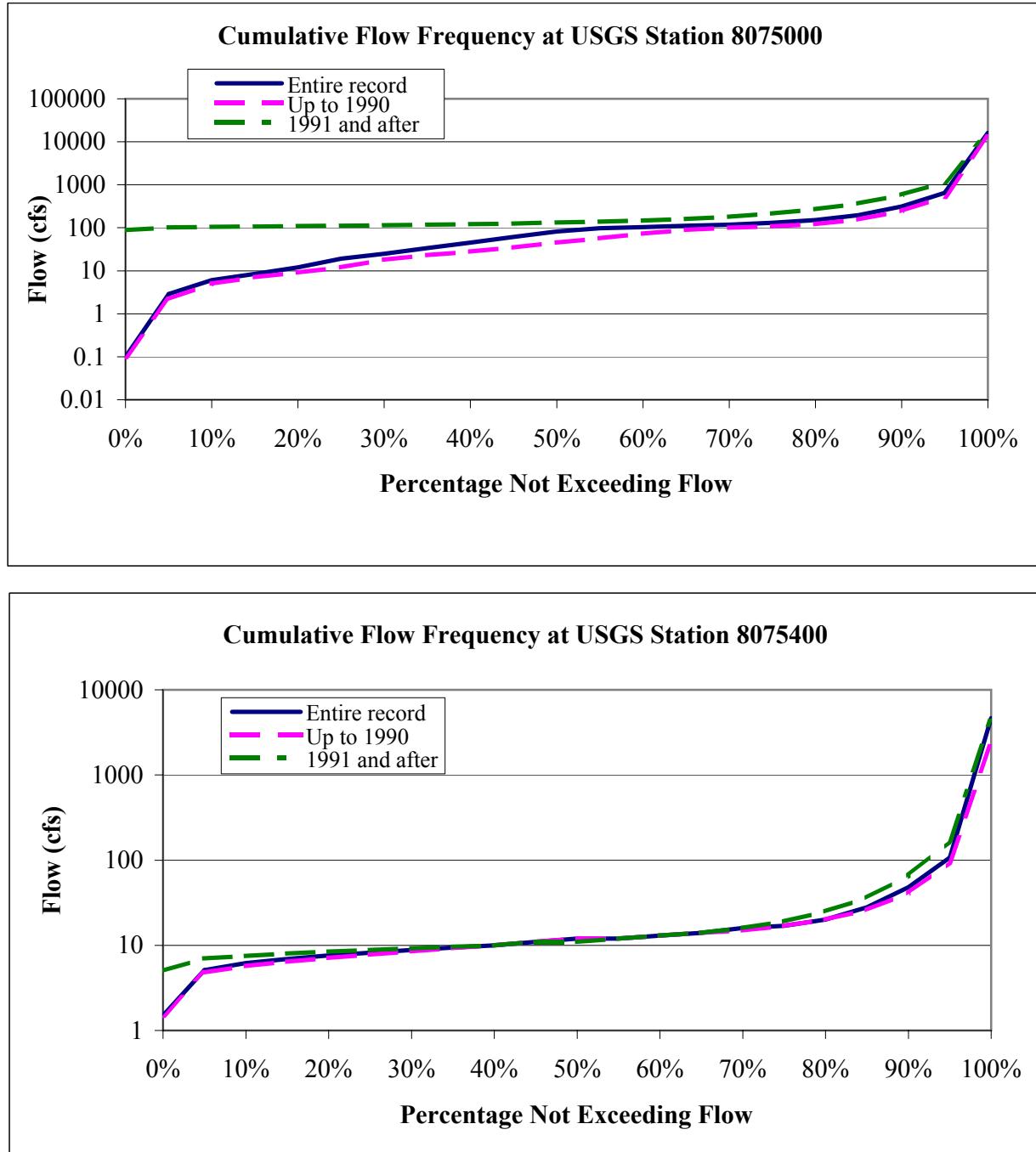
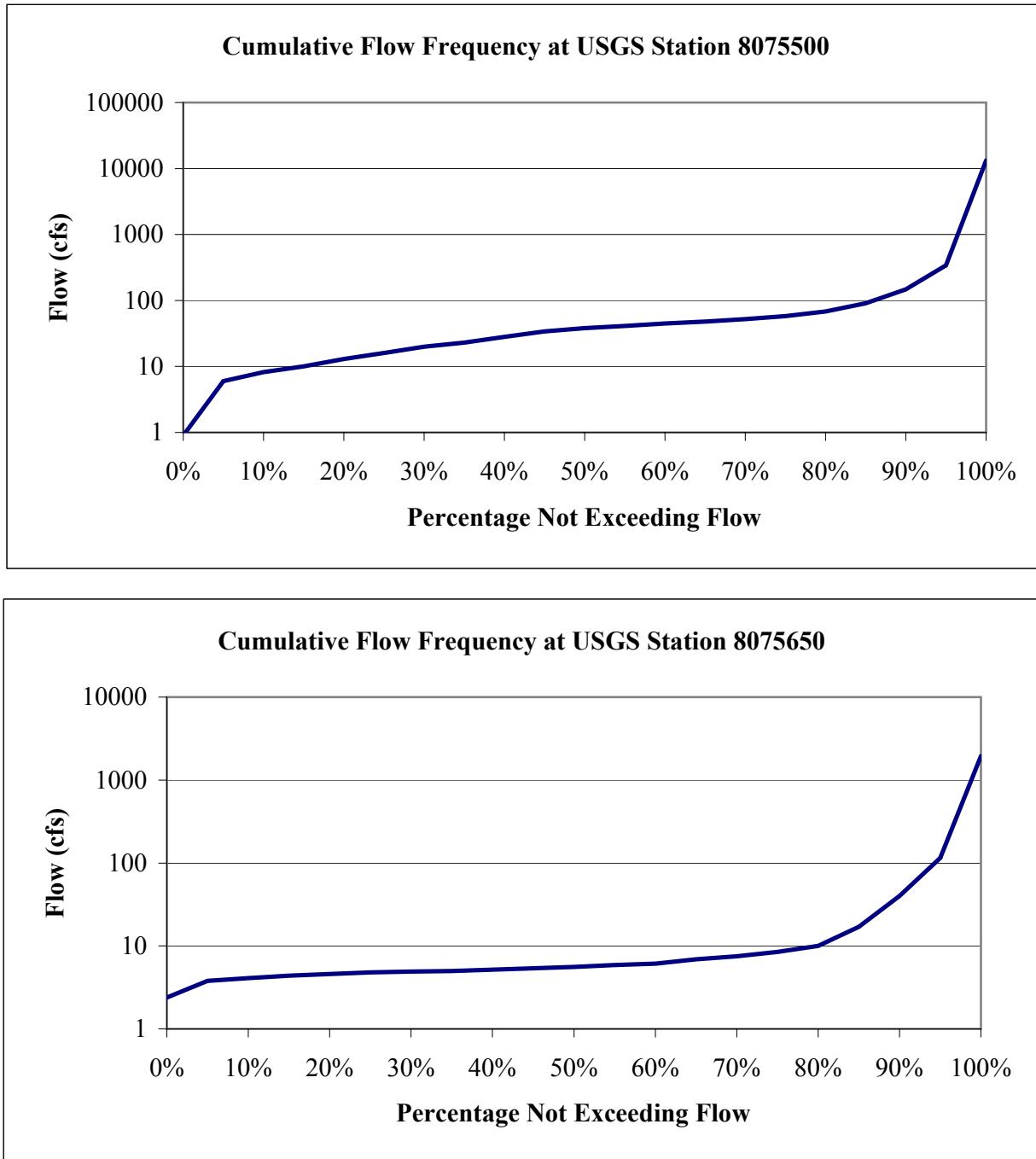


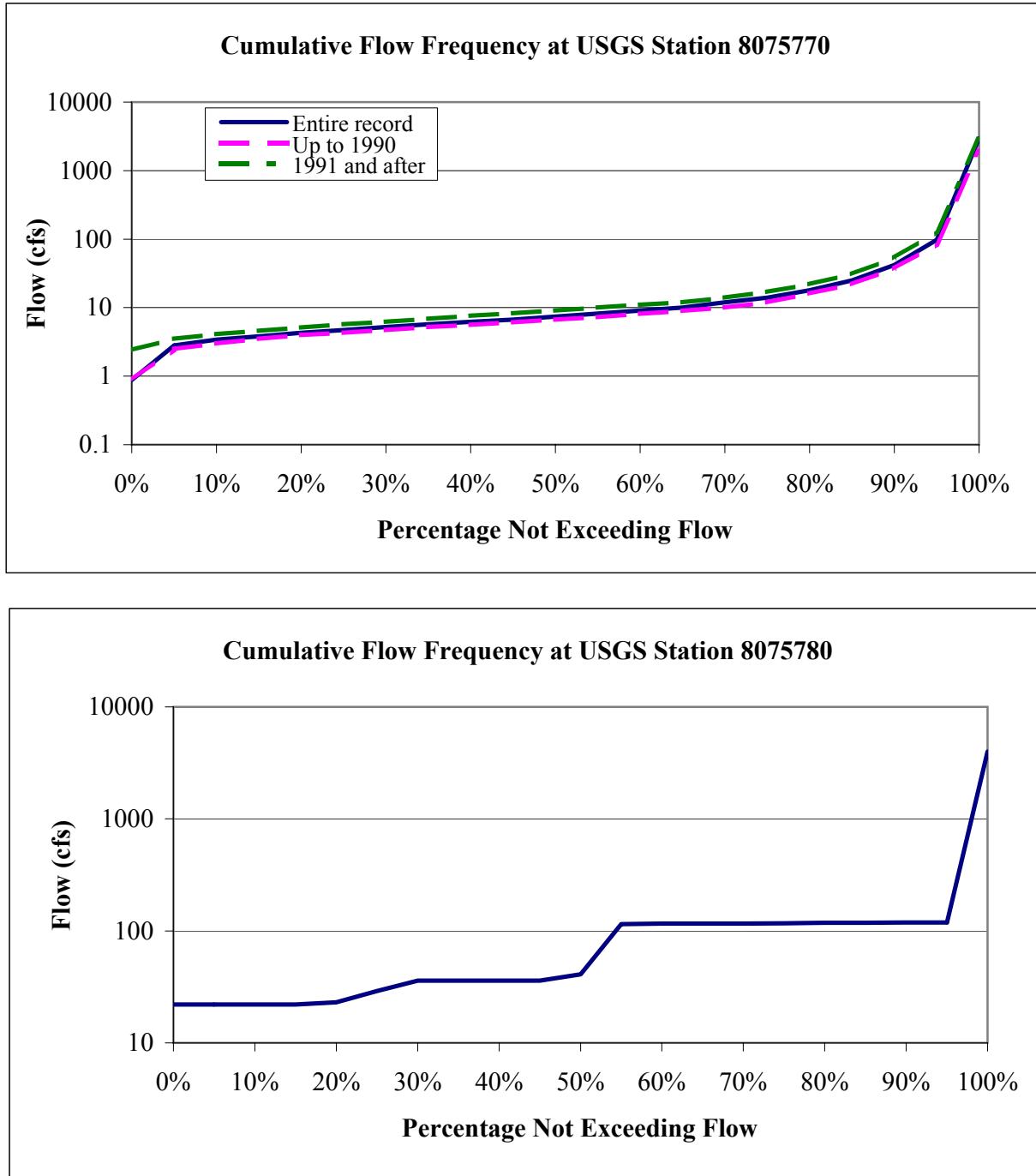
Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area



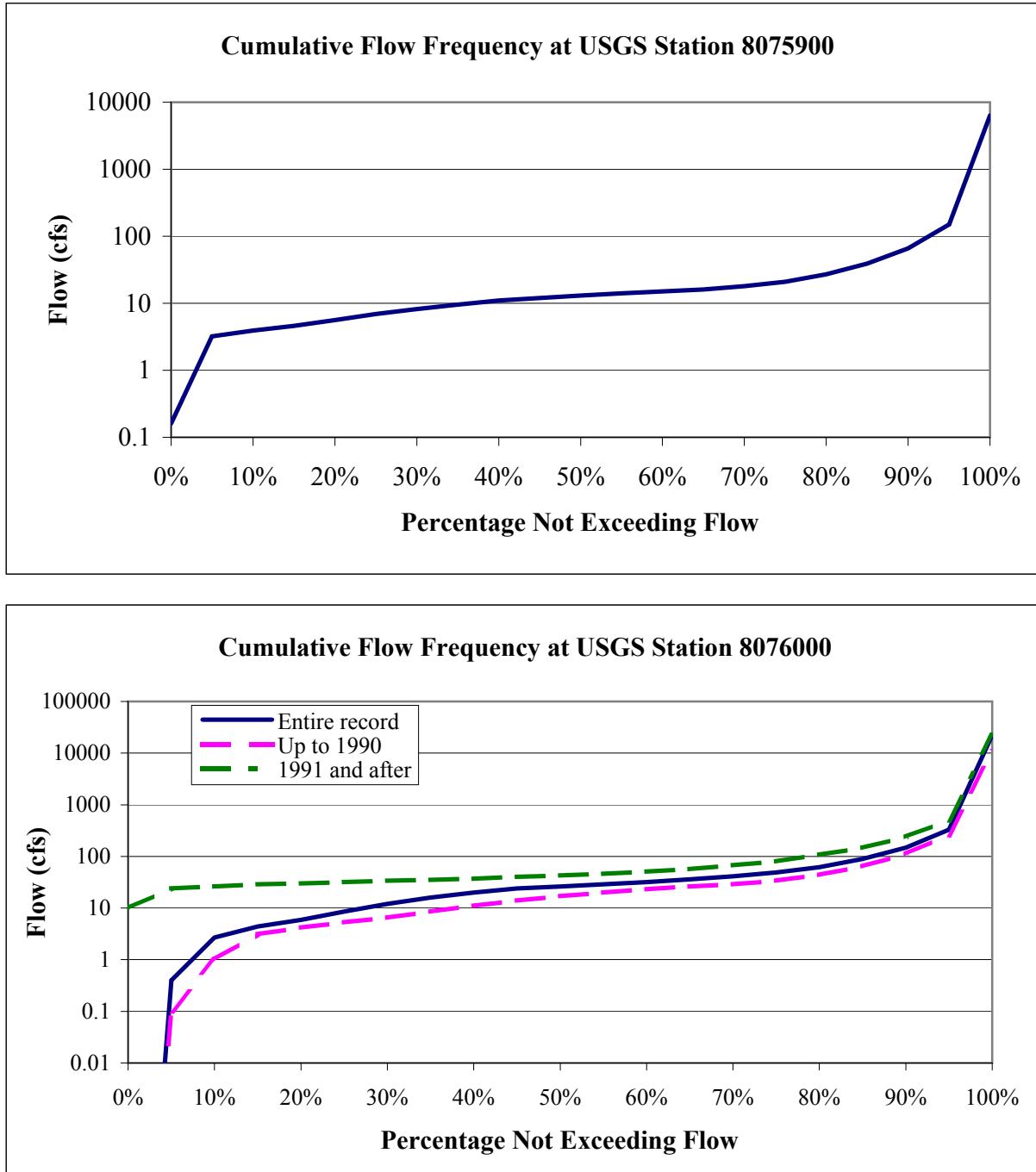
**Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area
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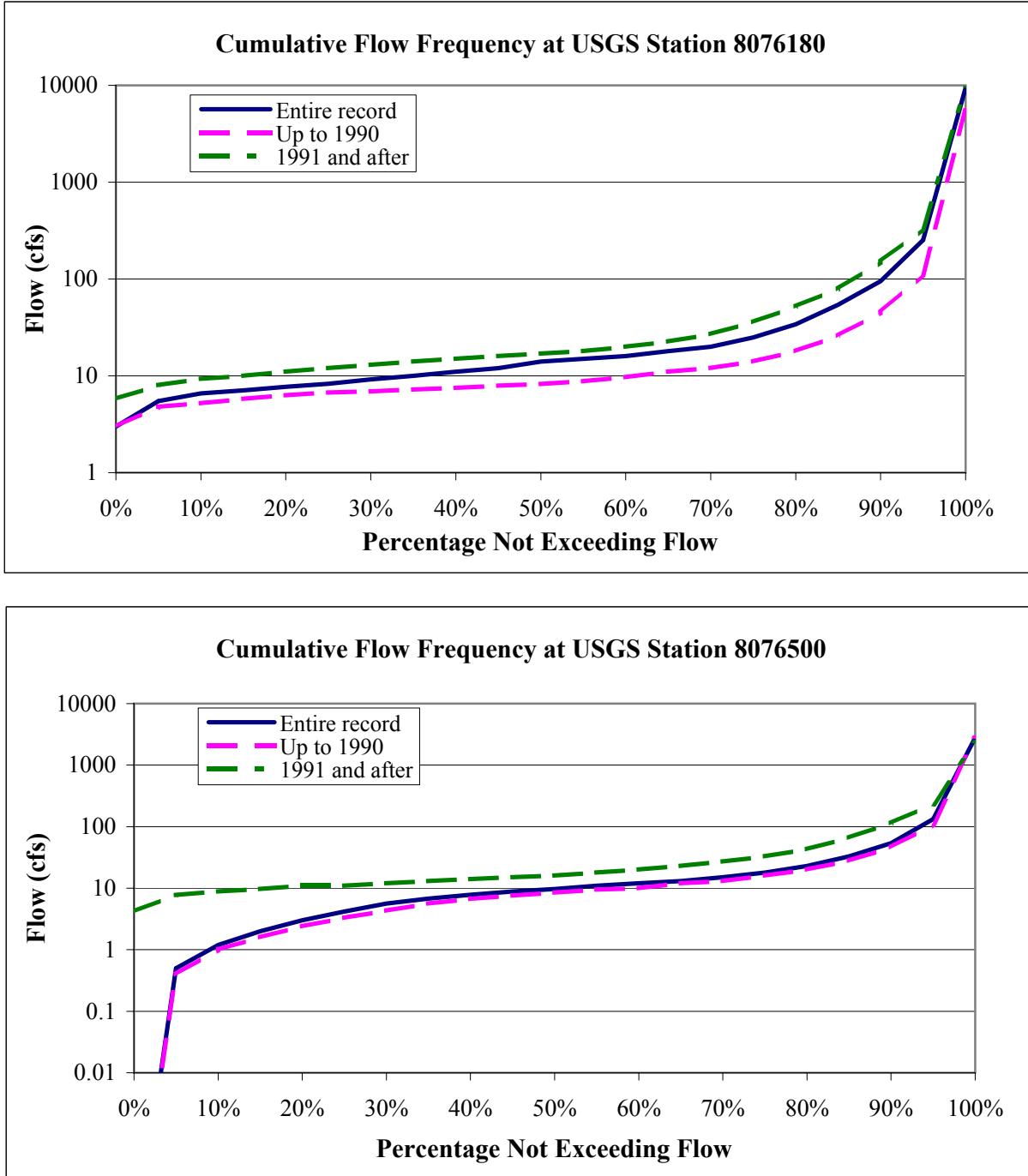
**Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area
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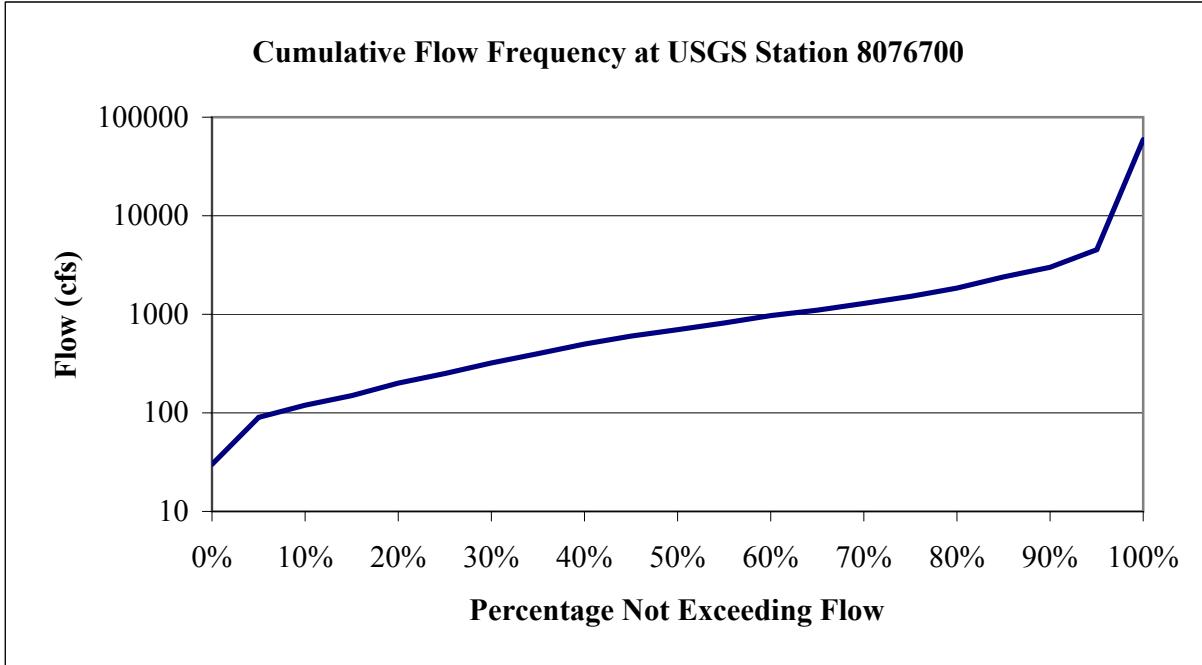
**Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area
Continued**



**Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area
Continued**



**Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area
Continued**



**Figure 2.5 Flow Cumulative Curves for USGS Gages in the Houston Metro TMDL Area
Continued**

Figure 2.3 shows TCEQ monitoring stations with bacteria data (fecal coliform and/or *E. coli*). As can be observed the sampling network is extensive and seems to adequately cover most of the water quality segments included in this TMDL. Bacteria data for all the stations were obtained from the TCEQ TRACS database for the entire period of record. A summary of EC data gathered for the segments included in this TMDL study is presented in Table 2.3. As can be seen, the not-to-exceed standard of 394 MPN/dL is exceeded in 80% of the samples (1805 out of 2265), with 90% of the stations exceeding more than 95% of the time.

Time series of FC/EC concentrations by station by segment are shown in Figures 2.6a through c. It can be seen in Figure 2.6a that most of the fecal indicator concentrations show no trend or increasing trend over time for the stations in non-tidal 1006 segments. Fecal indicator levels in the 1007 non-tidal segments, on the other hand, seem to be stable or decreasing over time for most of the stations (Figure 2.6b). Finally, fecal indicator concentrations in segment 1016 (Figure 2.6c) are not changing over time for most of the stations. It is noted that the temporal trends were determined by visual inspection of the best-fit trend line and their statistical significance has not been confirmed. Statistical analyses to evaluate temporal trends are underway.

Figure 2.7 shows EC concentration profiles along five major streams covered under this TMDL study. These data provide an indication of spatial patterns. Data in Figure 2.7 show that the geometric mean standard of 126 MPN/dL is exceeded at all stations in these five streams. Data also show that the geometric mean does not change significantly along the streams and that the EC levels in the tributaries are generally at or below the levels measured in the main stem at the point of discharge. The only exception

Table 2.3 Summary of EC Data in the Houston Metro TMDL Area

Stream	Station ID	Tributary	# samples	Geometric Mean (MPN/dL)	# > 126 MPN/dL	# > 394 MPN/dL
Brays Bayou	11138		37	5078	36	36
	11139		48	3292	48	46
	11140		34	4807	34	33
	11309		37	7375	37	37
	15848		33	918	32	23
	15849		34	683	30	22
	15850		34	1667	34	30
	15851		34	3756	34	31
	15852		34	3641	34	33
	15853		32	4799	32	32
	15854		32	5996	32	32
	15855		32	3052	32	31
	15859		31	3241	31	30
	11169	x	34	2317	34	34
Greens Bayou	16652	x	32	1761	29	25
	16654	x	34	1519	34	31
	11369		55	410	41	25
	11370		37	500	30	19
	11371		37	1210	35	29
	11376		35	492	30	19
	13778		55	1727	55	49
	17495		35	276	27	11
	11124	x	37	1283	36	32
	11125	x	36	629	32	18
	16589	x	37	433	28	18
	16590	x	37	581	29	22
	16676	x	37	1655	36	29
Halls Bayou	11126		37	3440	37	35
	11127		36	1614	35	30
	15862		36	1850	35	30
	15863		37	2585	37	37
	15864		55	1220	52	44
	17490		35	3799	34	32
	17491		35	854	32	27
	16665	x	37	2083	36	33
	16666	x	37	1852	37	33
	16667	x	36	874	36	26
Hunting Bayou	11128		35	866	31	25
	11129		37	335	30	13
	15867		37	510	32	25
	15873		37	656	25	20
	15869	x	37	26257	36	35
	16657	x	37	661	30	24

Table 2.3 Summary of EC Data in the Houston Metro TMDL Area

Stream	Station ID	Tributary	# samples	Geometric Mean (MPN/dL)	# > 126 MPN/dL	# > 394 MPN/dL
Sims Bayou	11133		52	1776	52	48
	11135		36	1183	34	28
	15876		36	2209	36	34
	15877		36	1699	36	32
	15878		37	1189	35	27
	16656		36	592	33	22
	15875	x	36	1222	32	29
	16655	x	36	829	35	25
Berry Bayou	16660		37	1734	36	33
	16661		37	1987	37	36
Big Gulch	16662		37	1766	32	27
Country Club	16650		37	6932	36	35
	16651		37	5026	35	31
Goodyear Creek	16664		36	10929	35	30
Pine Gully	16659		37	3994	36	34
Plum Creek	16658		37	7375	35	34
Spring Gully	16663		37	643	34	27
Unnamed Trib of Buffalo	16649		37	1289	30	27
TOTAL			2265		2116	1805

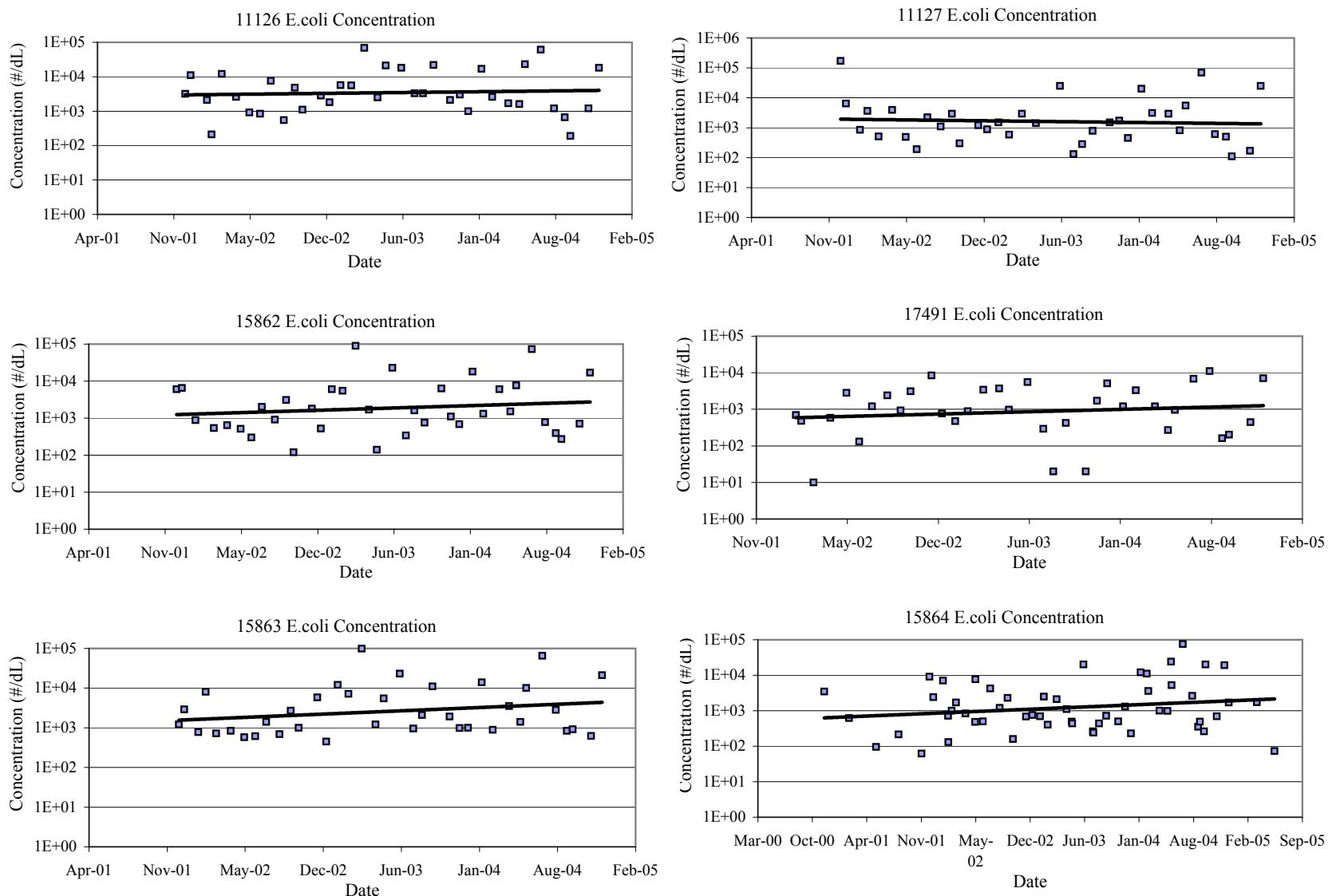


Figure 2.6a E. Coli /Fecal Coliform Data in 1006 Non-tidal Segments

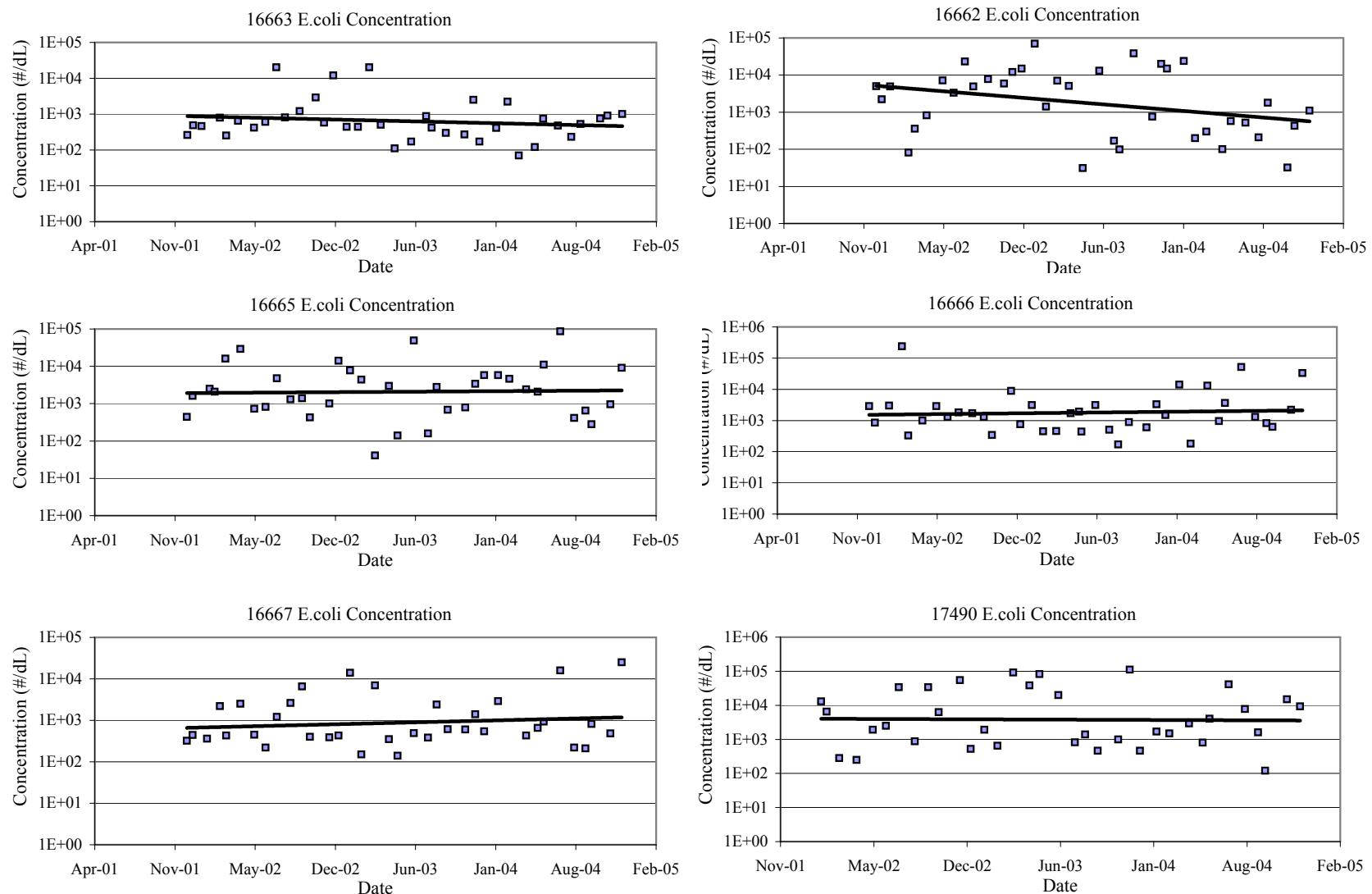


Figure 2.6a *E. Coli*/Fecal Coliform Data in 1006 Non-tidal Segments - Cont'd

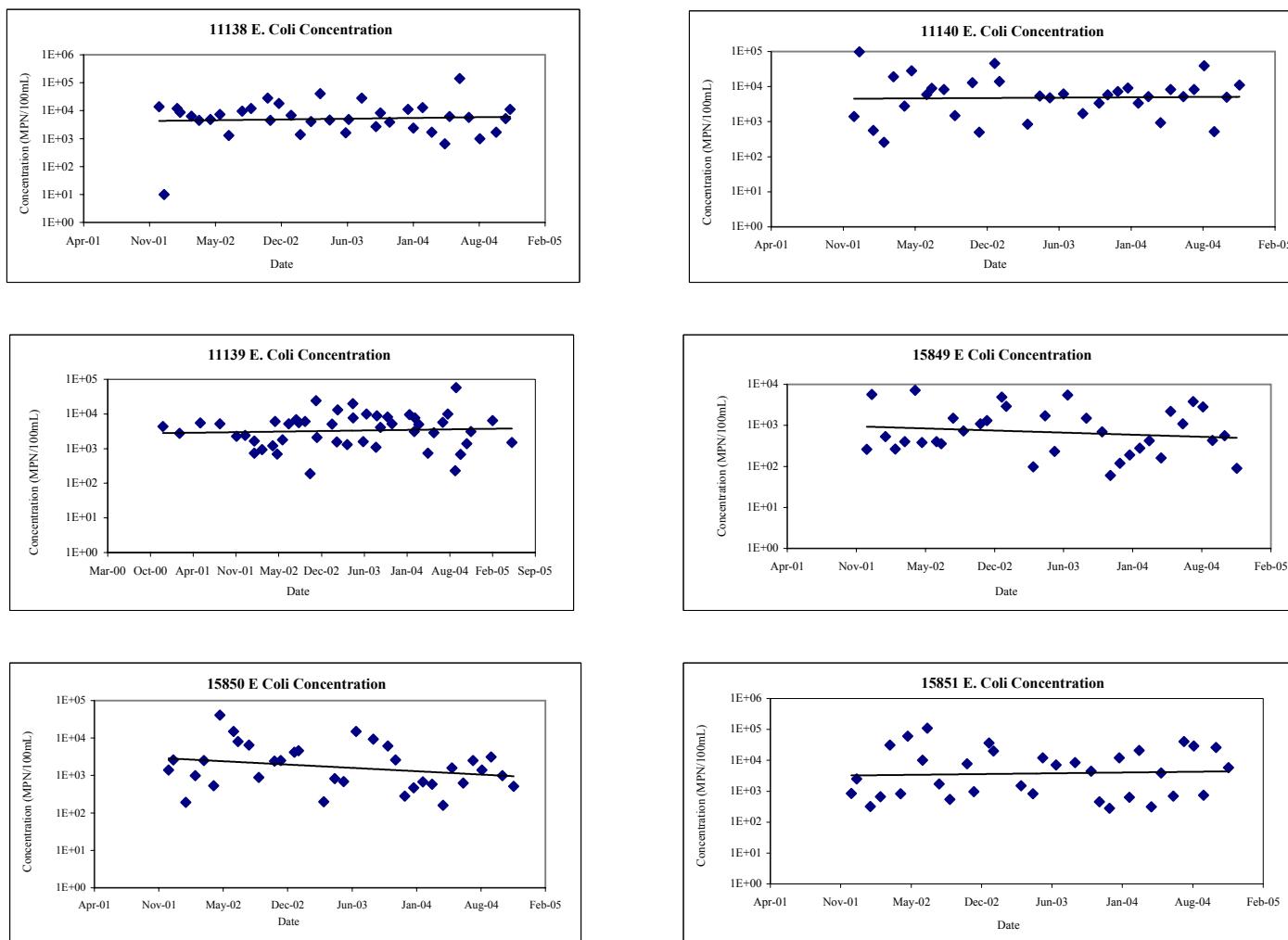


Figure 2.6b *E.Coli*/Fecal Coliform Data for Water Quality Stations - 1007B

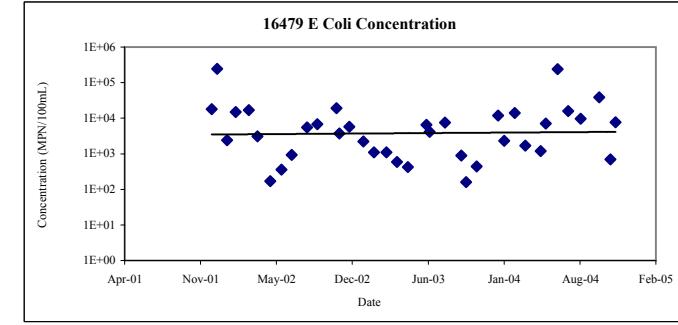
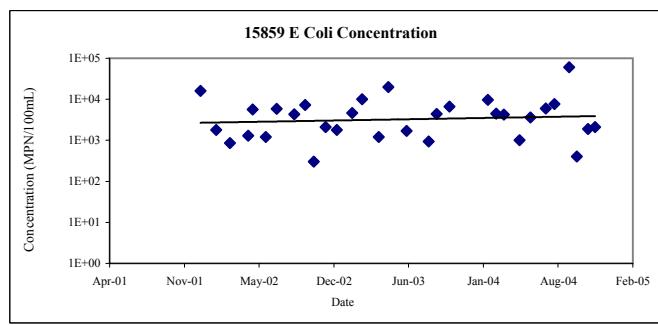
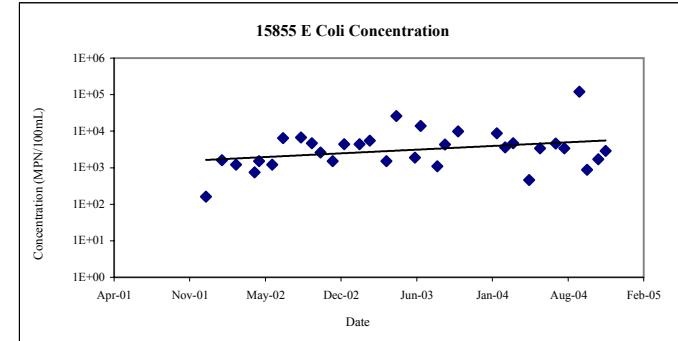
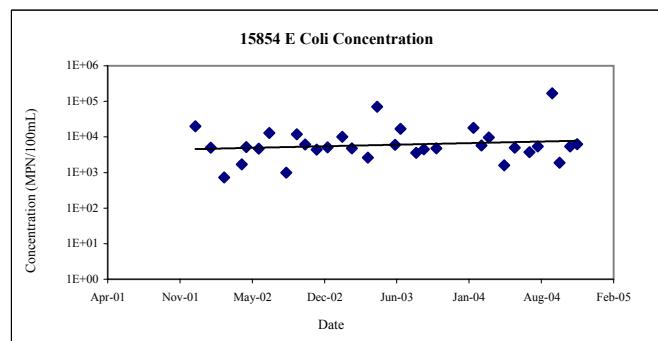
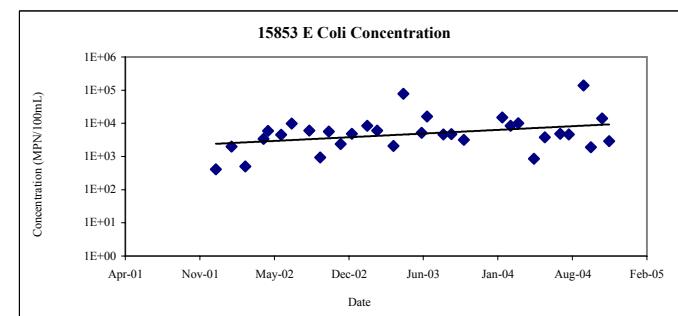
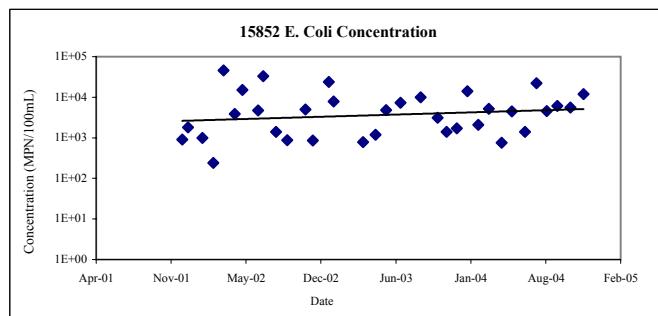


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007B

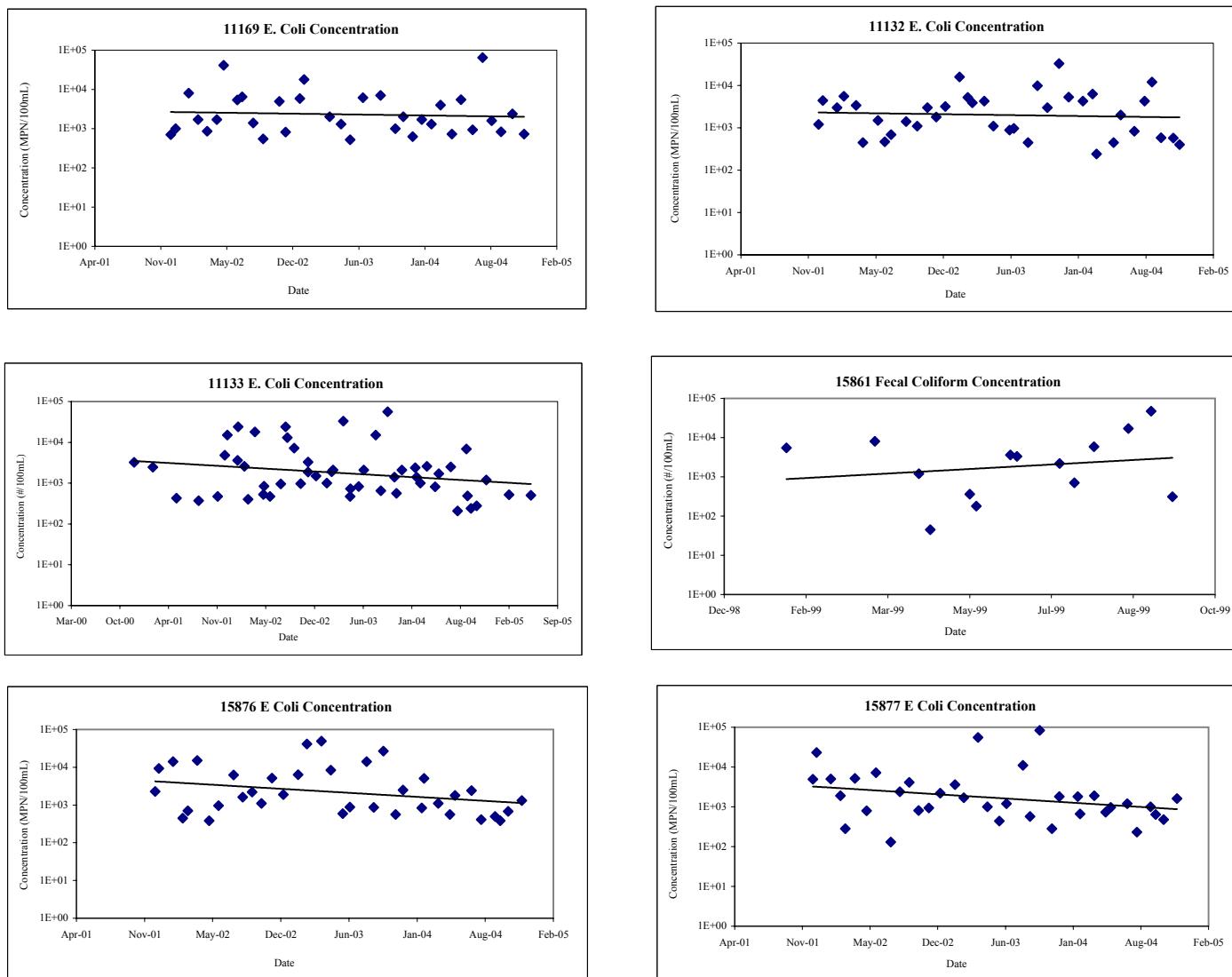


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007C & D

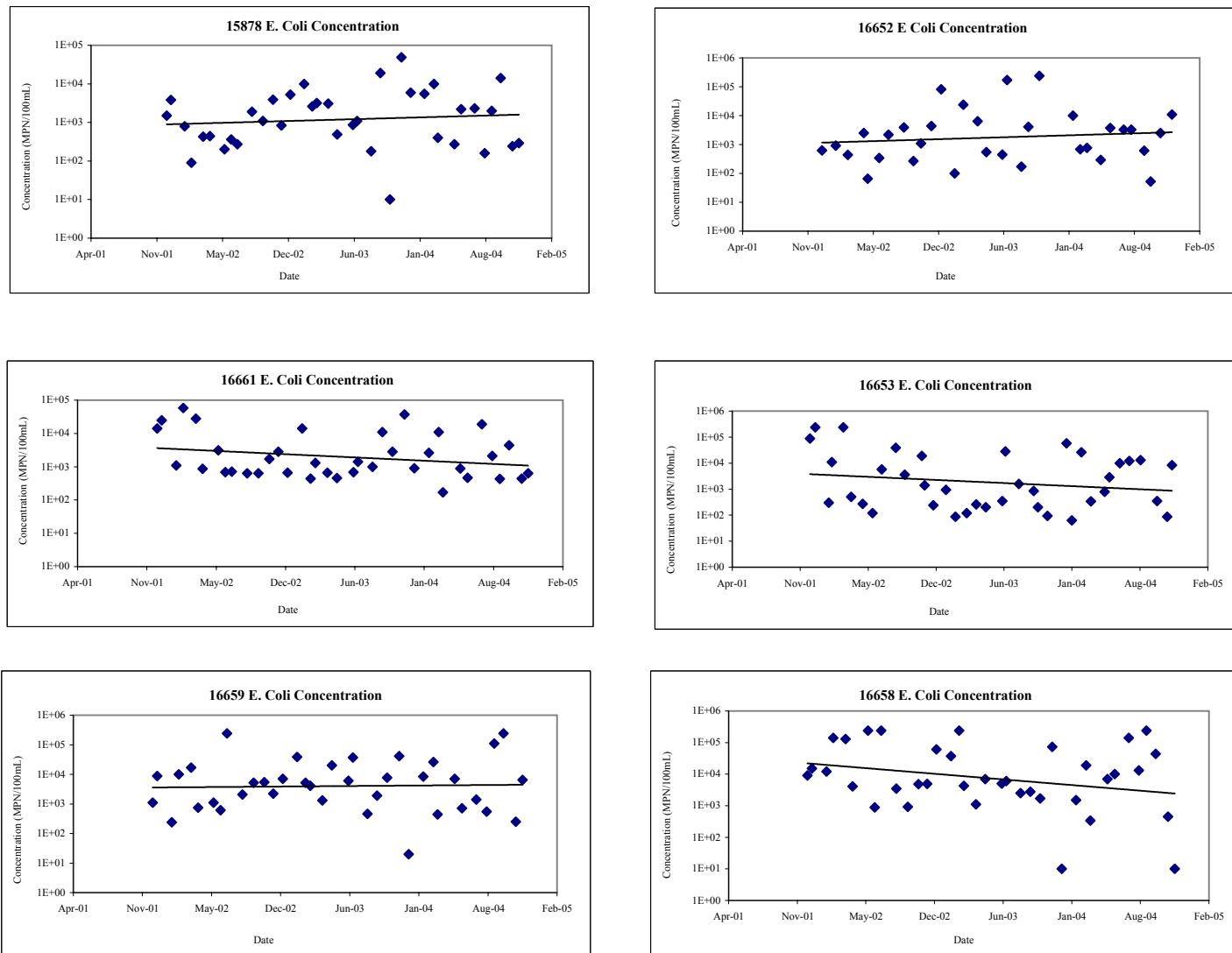


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007 D, E, F, G, H and I

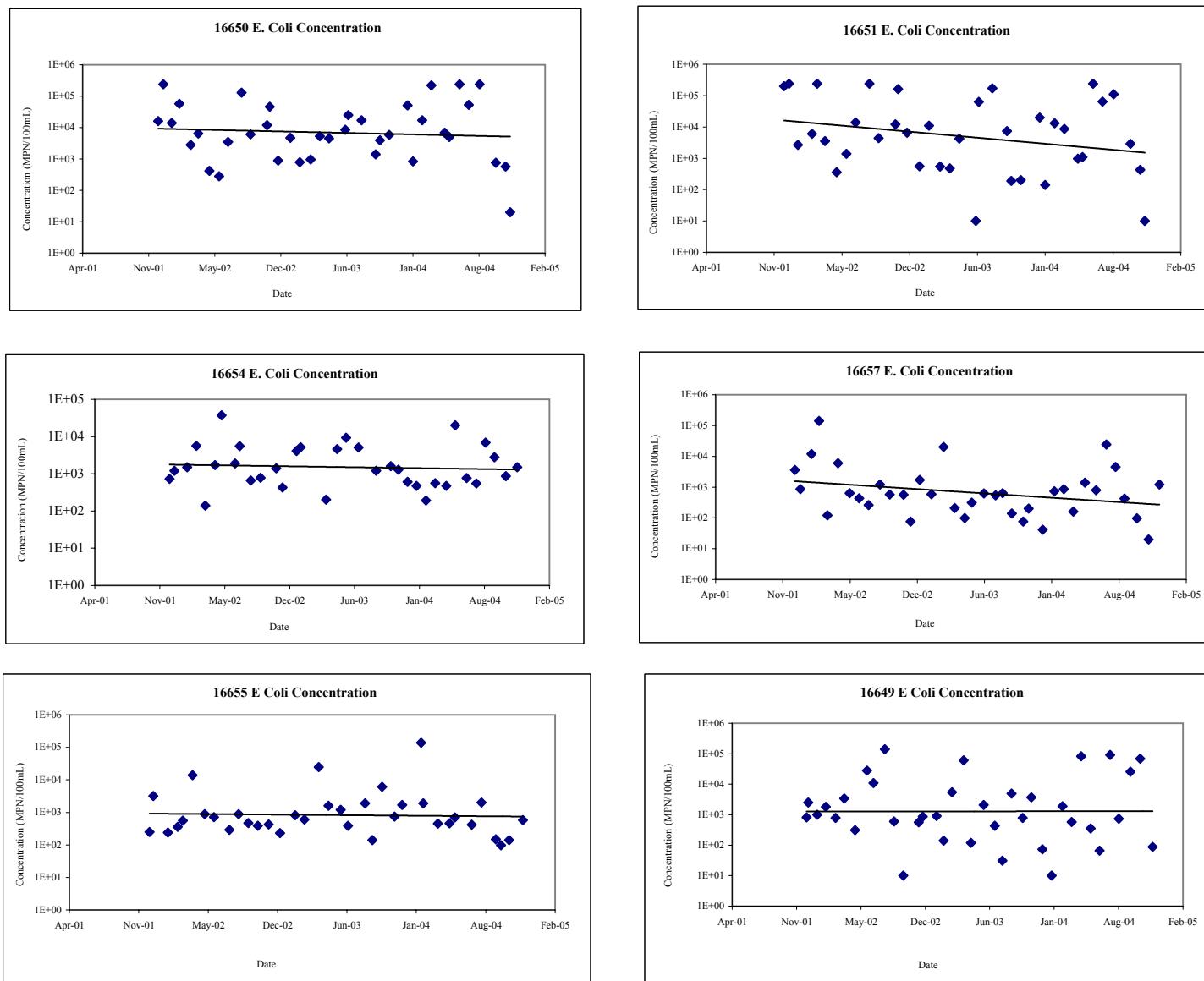


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007 K, L, M, N and O

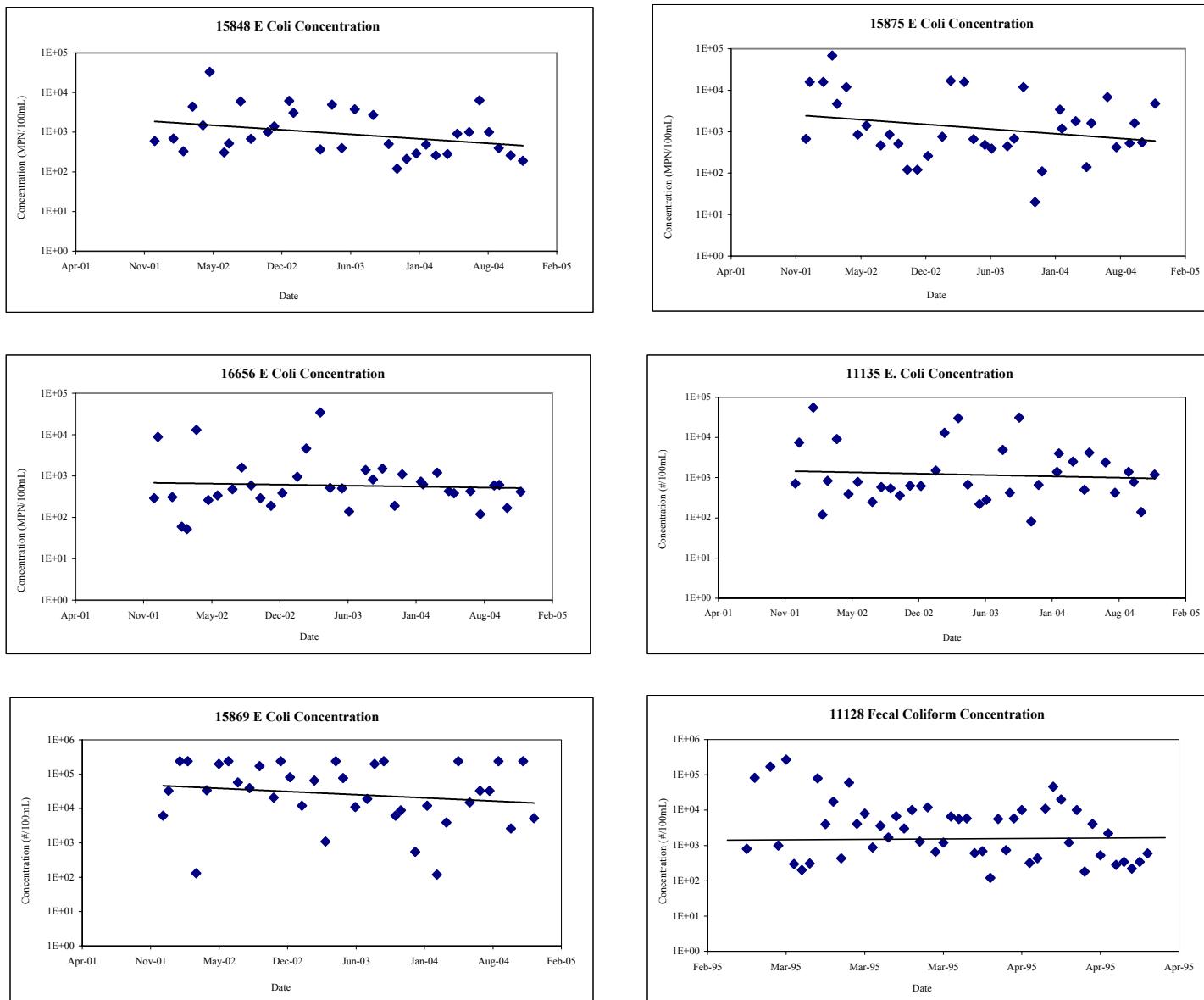


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007 P, Q and R

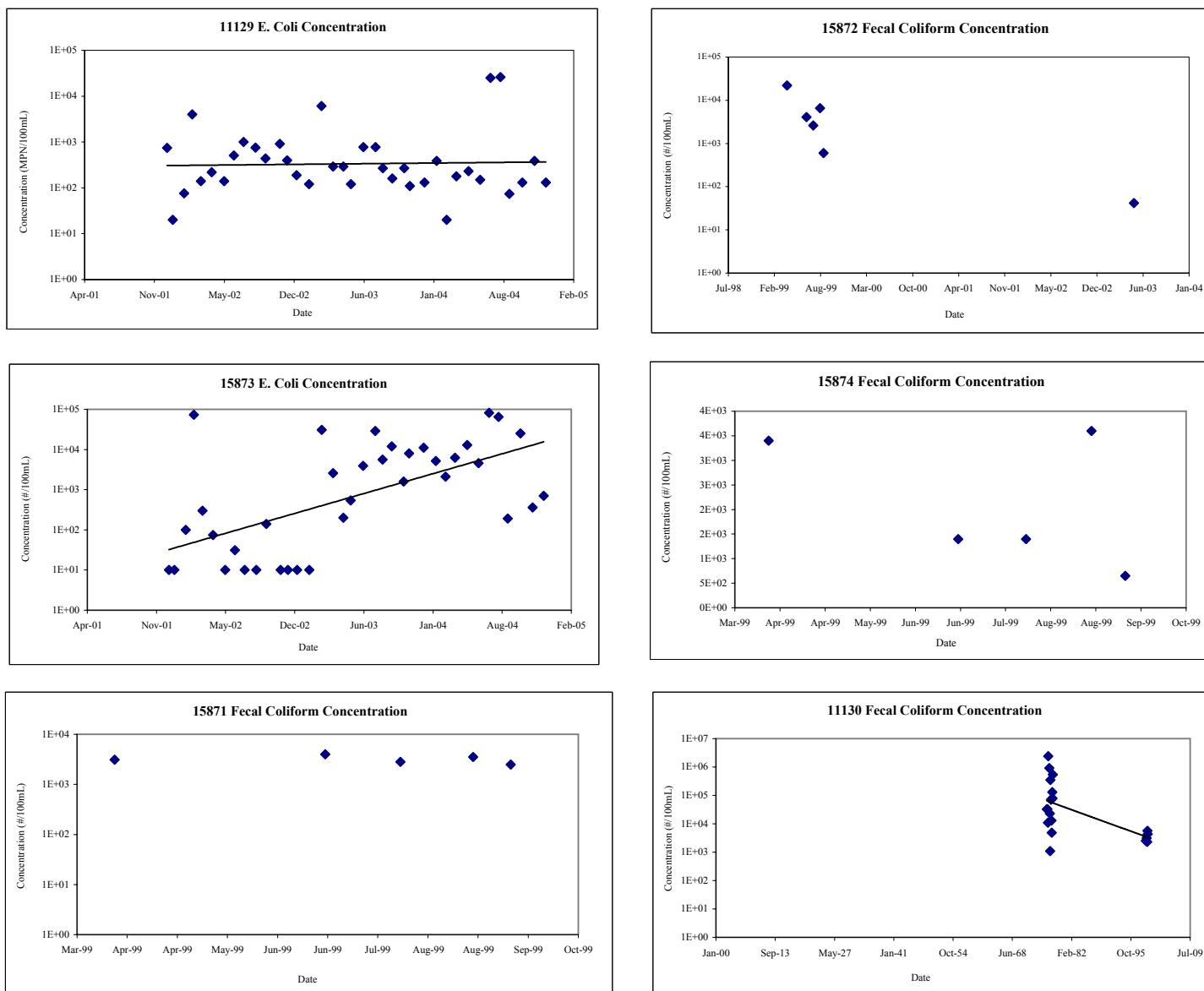


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007 R

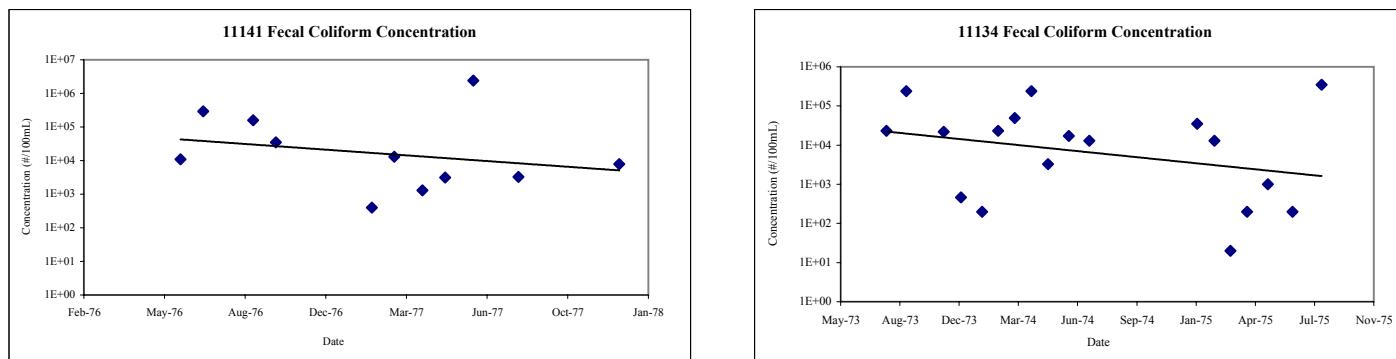


Figure 2.6b (Cont'd) E.Coli/Fecal Coliform Data for Water Quality Stations - 1007 B, D

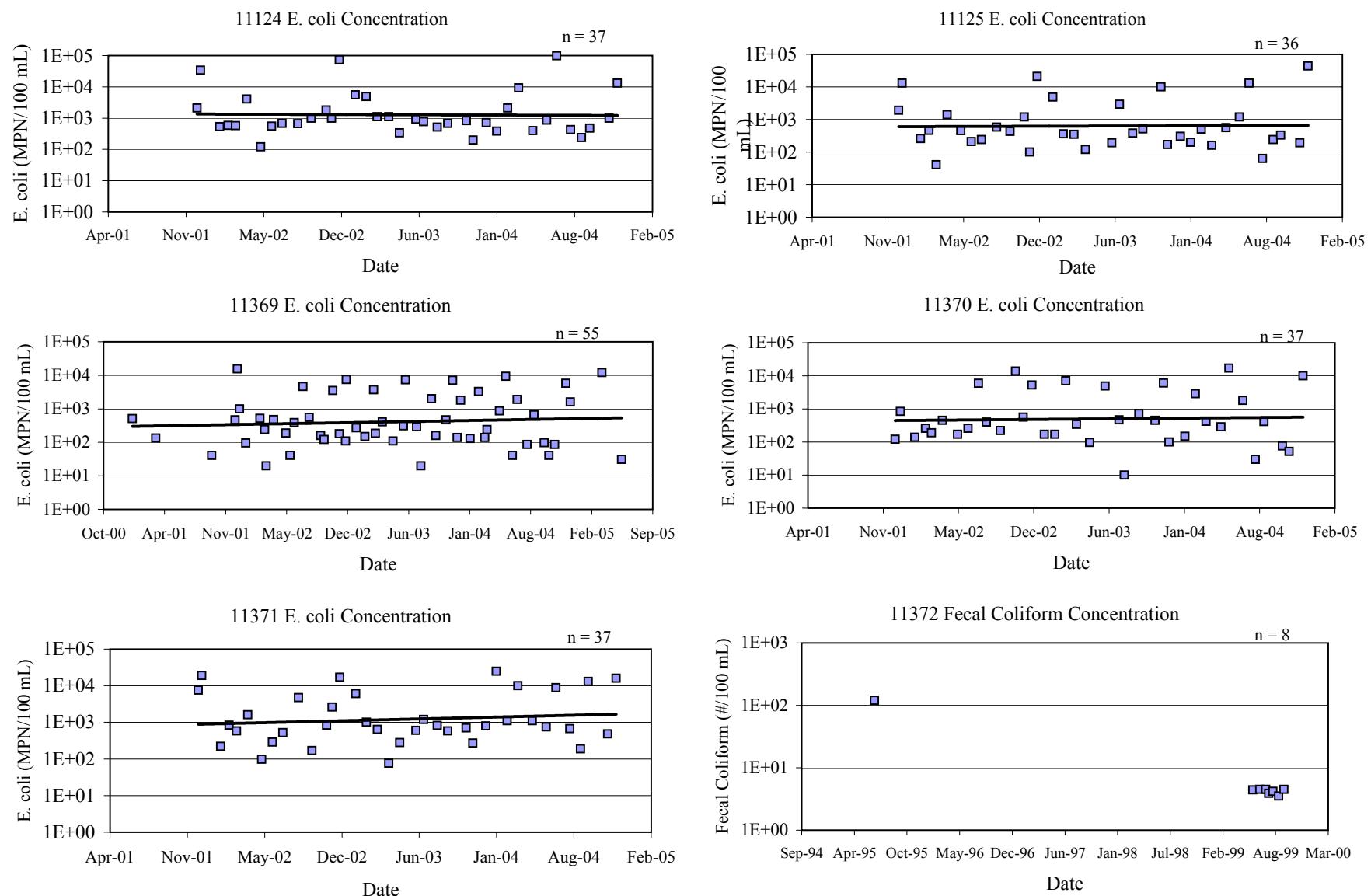


Figure 2.6c E. Coli /Fecal Coliform Data in Segment 1016

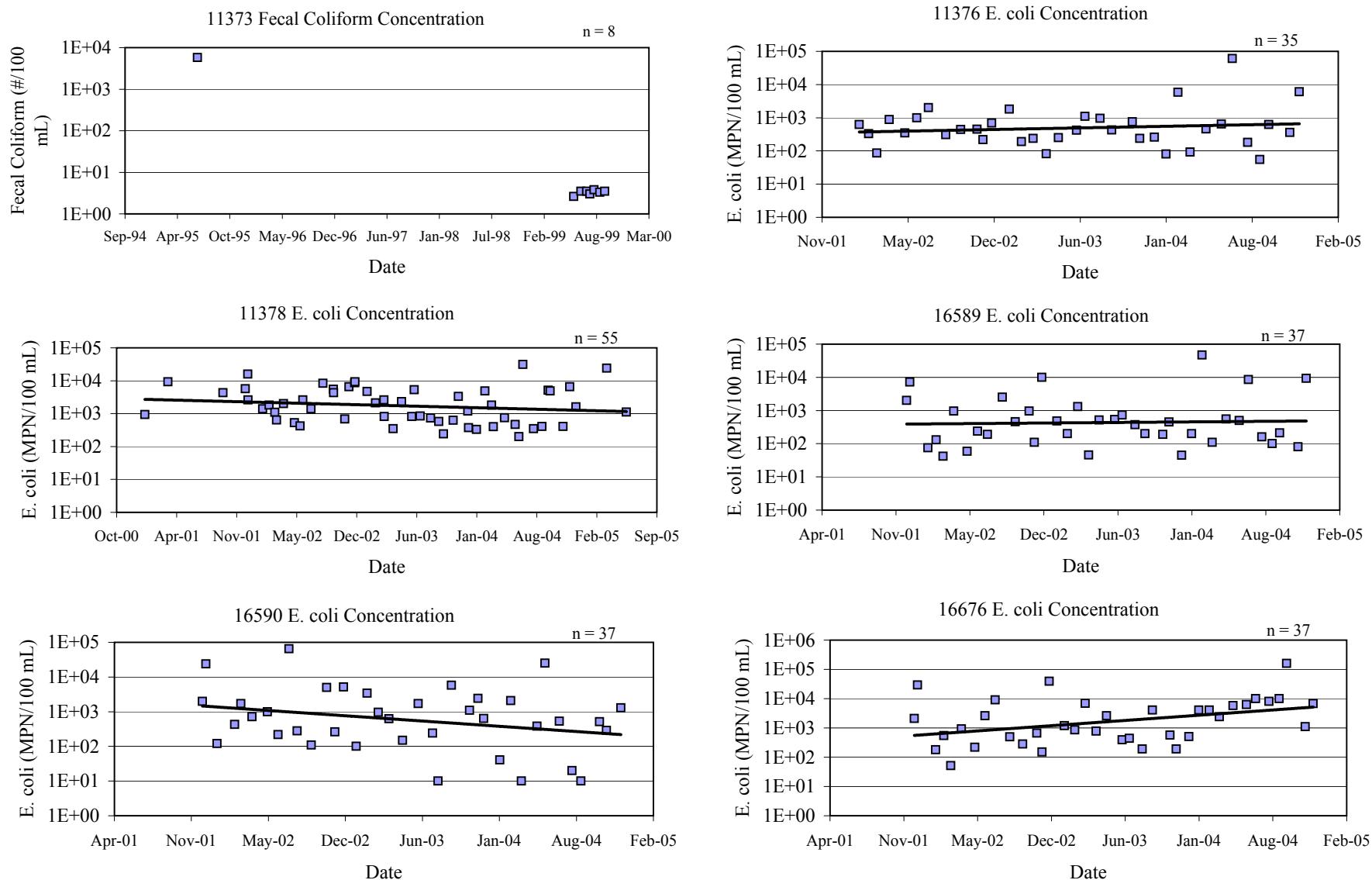


Figure 2.6c E. Coli /Fecal Coliform Data in Segment 1016 - Cont'd

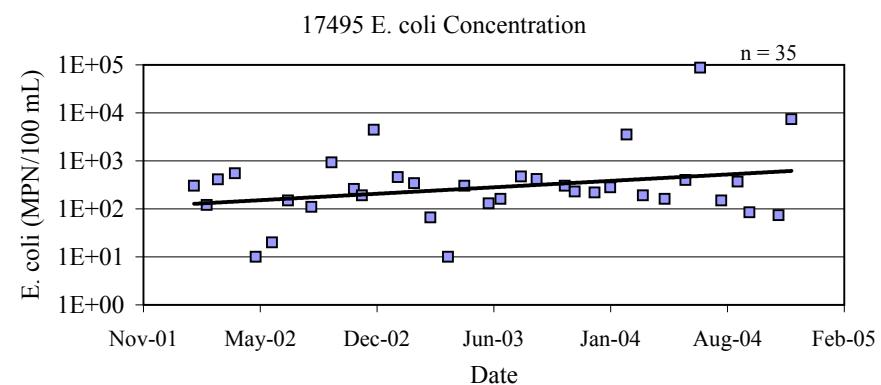


Figure 2.6c E. Coli /Fecal Coliform Data in Segment 1016 - Cont'd

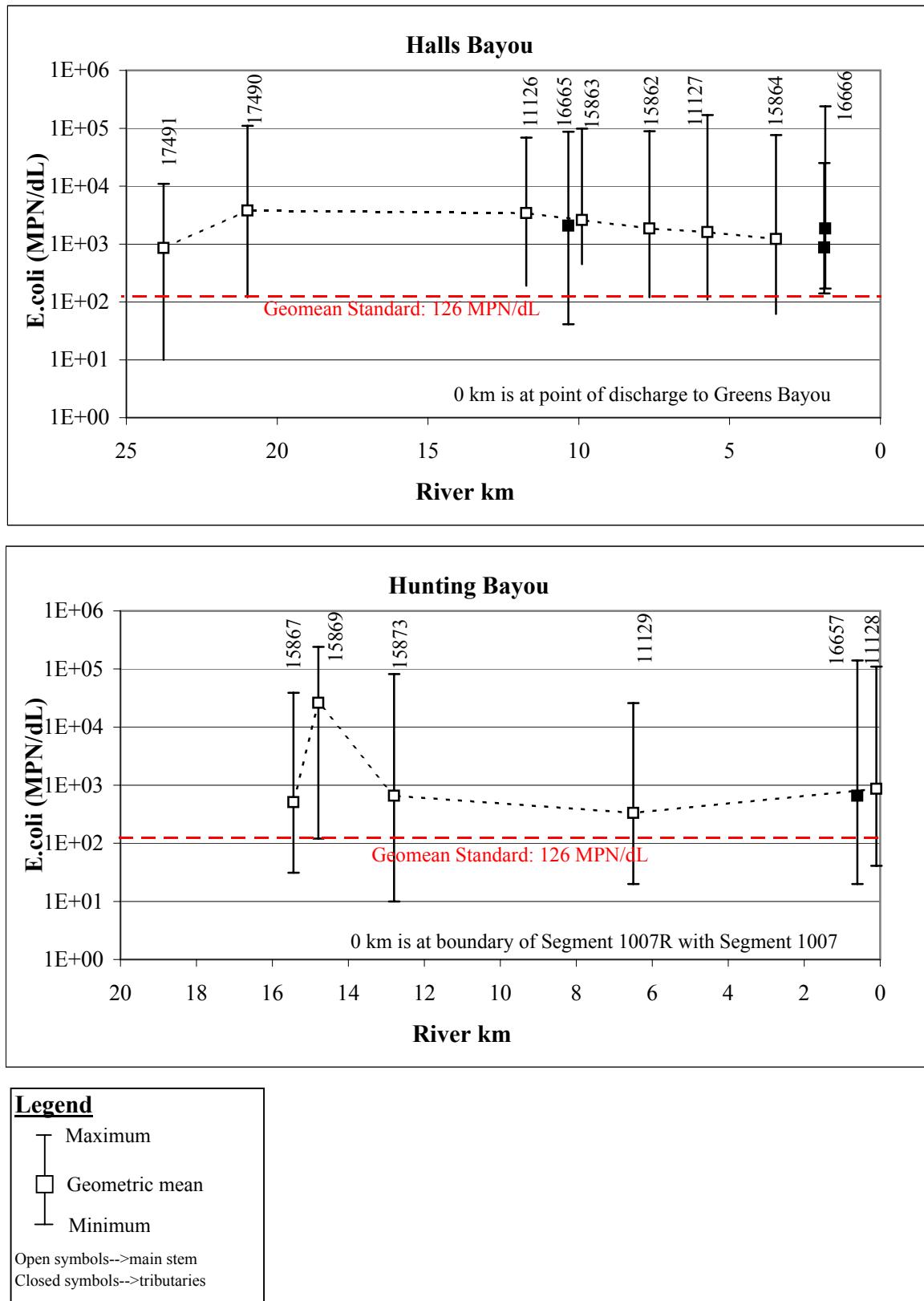
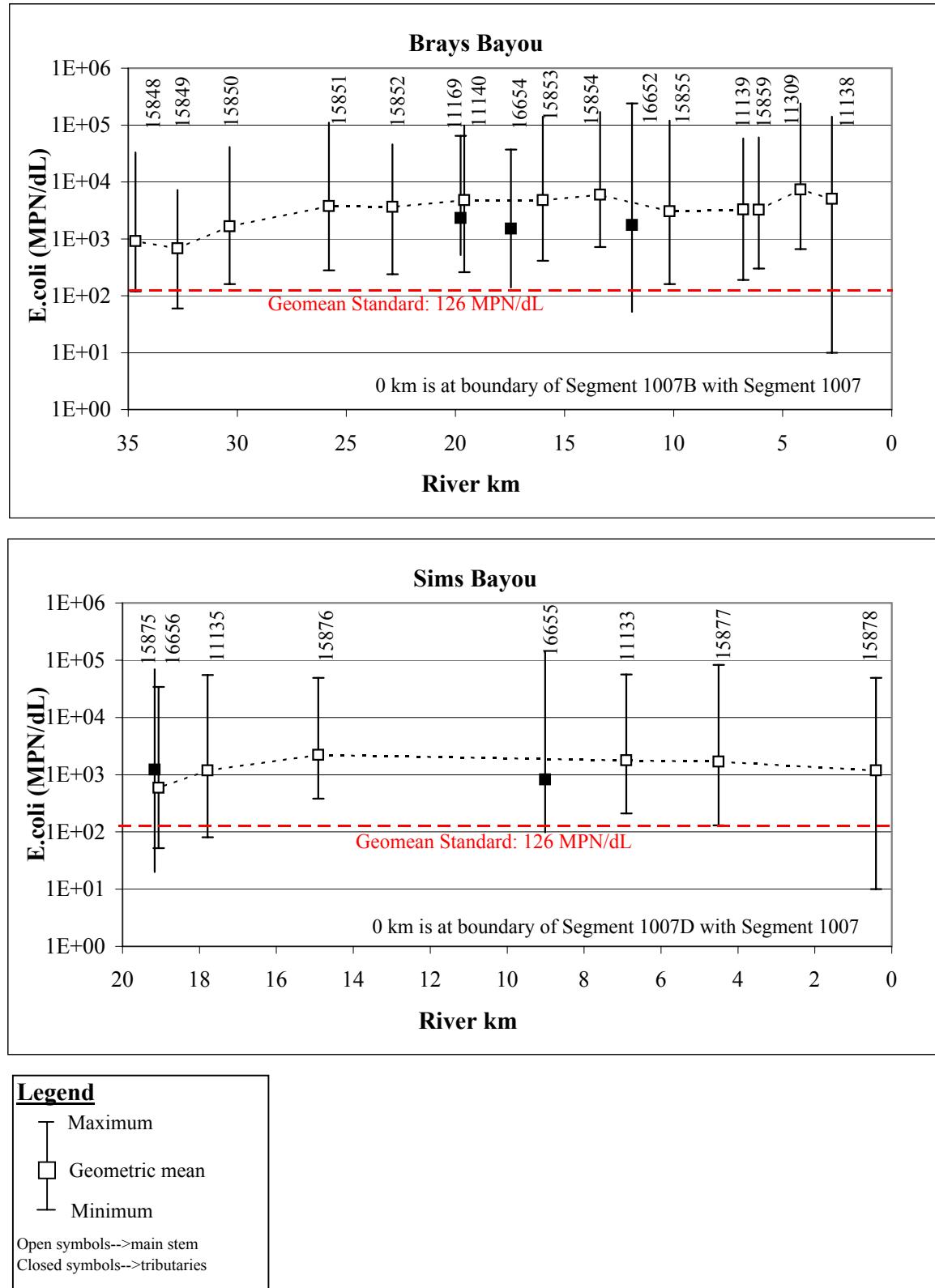
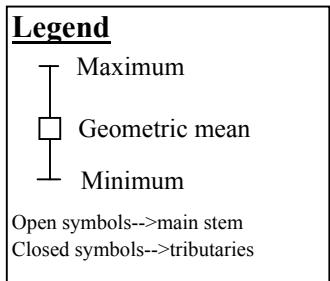
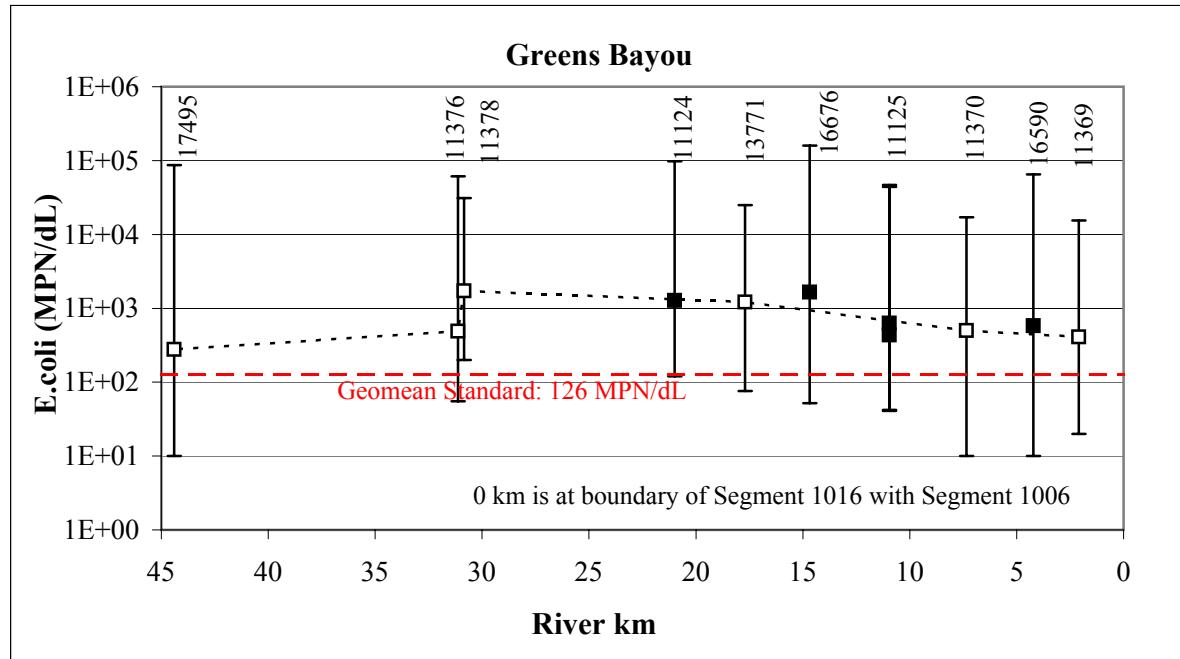


Figure 2.7 Longitudinal EC Profiles for Major Streams in the Houston Metro TMDL Study



**Figure 2.7 Longitudinal EC Profiles for Major Streams in the Houston Metro TMDL Study
Continued**



**Figure 2.7 Longitudinal EC Profiles for Major Streams in the Houston Metro TMDL Study
Continued**

to the relatively “stable” spatial trend is station 15869 in Hunting Bayou that presents a geometric mean that is 2 orders of magnitude higher than those measured at other sites along the same stream. Spatial trends were evaluated using linear regressions as summarized in Table 2.4. As can be seen in Table 2.4, the only stream that presented a statistically significant spatial trend is Brays Bayou, for which EC geometric means are increasing longitudinally from upstream to downstream.

Table 2.4 Parameters for Linear Regressions of Geometric Means over Distance

Stream	Slope	R ²	p-value
Halls Bayou	-31	0.045	0.6469
Hunting Bayou	-719	0.167	0.4937
Brays Bayou	122	0.498	0.0070
Sims Bayou	20	0.074	0.6013
Greens Bayou	-3	0.008	0.8666

Green shading indicates a statistically significant trend

Total Suspended Solids (TSS) data for the segments included in this TMDL study were also downloaded from the TCEQ TRACS database. Figure 2.8 shows time series of TSS data for all the stations with available data.

Finally, Table 2.5 presents a summary of the available fecal indicator/flow data for this project and lists data gaps and needs.

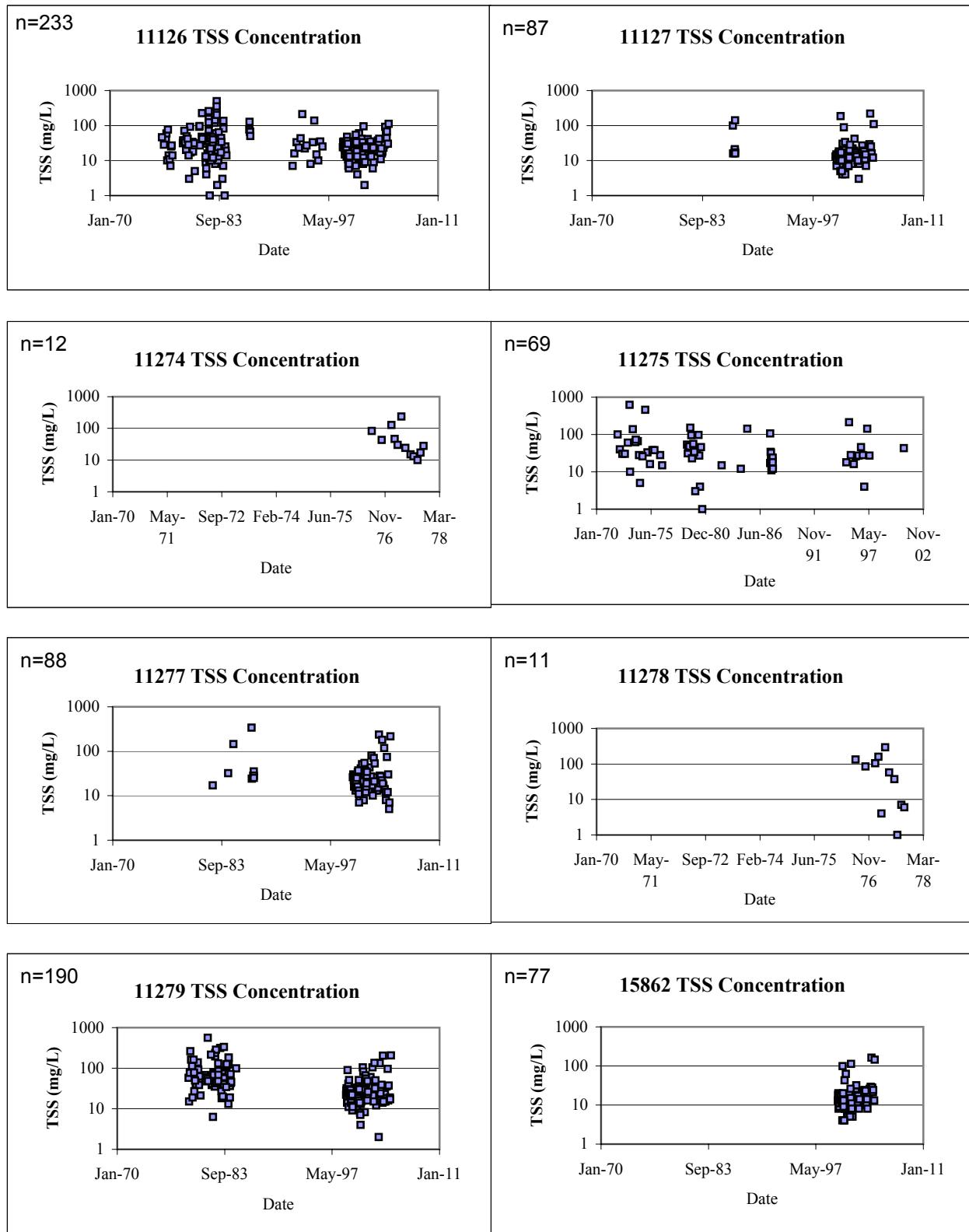


Figure 2.8a TSS Data in 1006 Non-tidal Segments

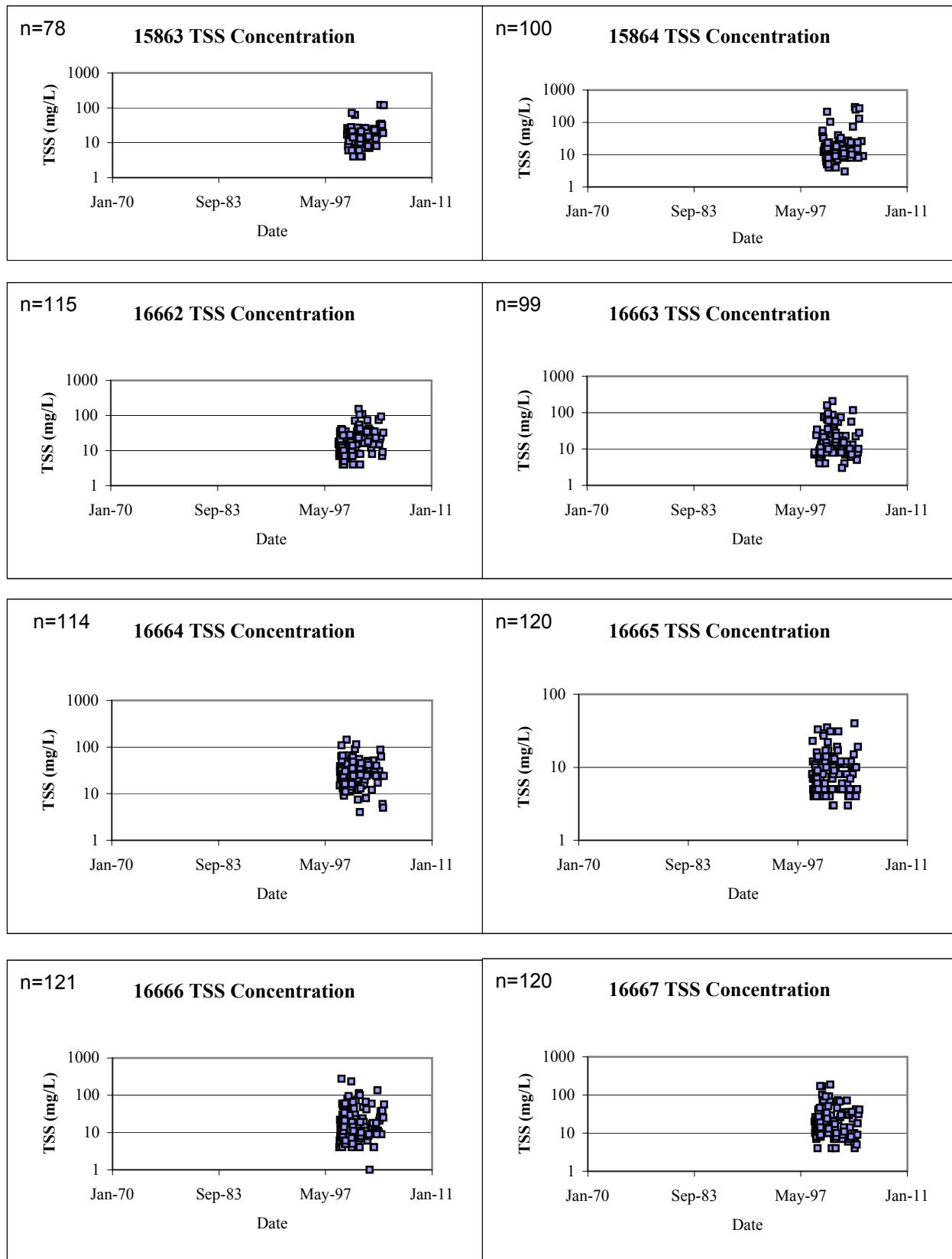


Figure 2.8a TSS Data in 1006 Non-tidal Segments - Cont'd

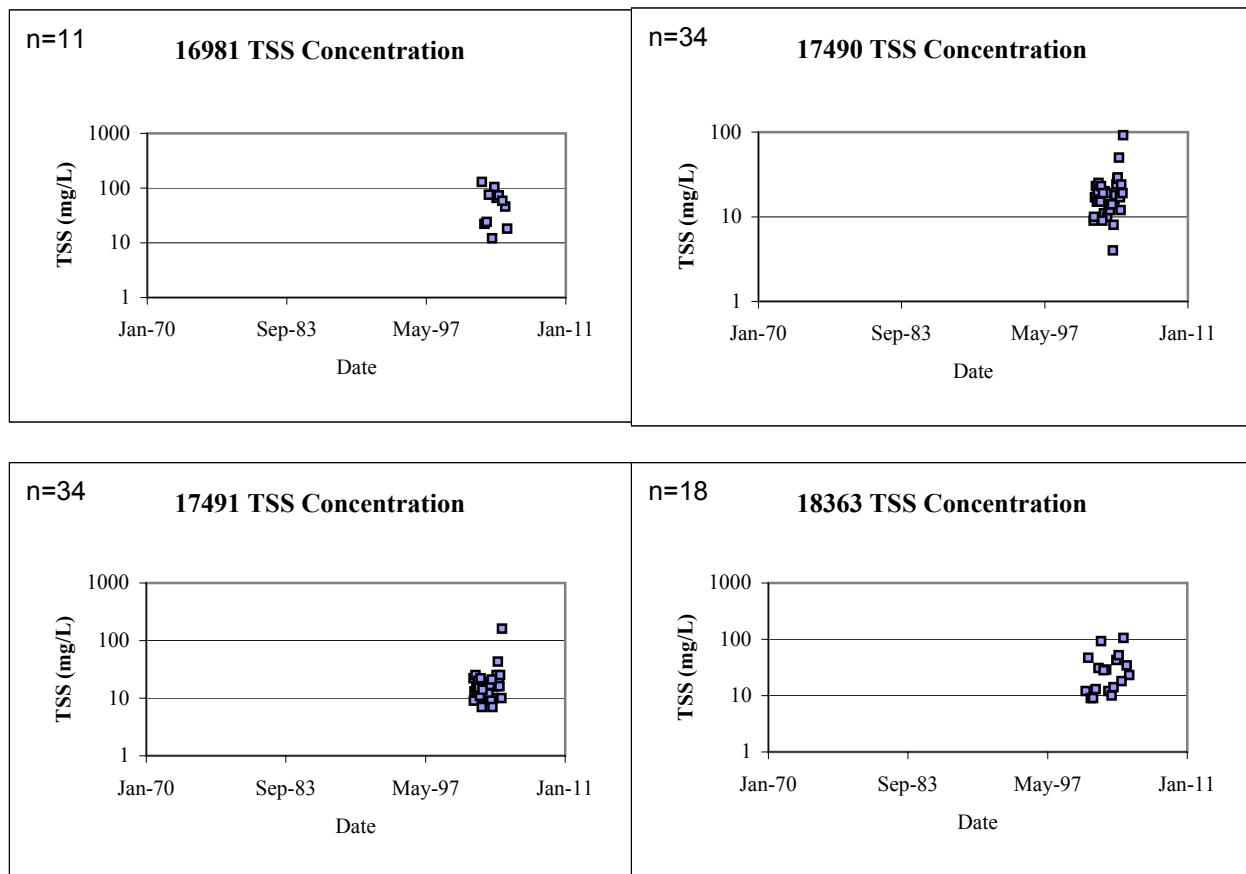


Figure 2.8a TSS Data in 1006 Non-tidal Segments - Cont'd

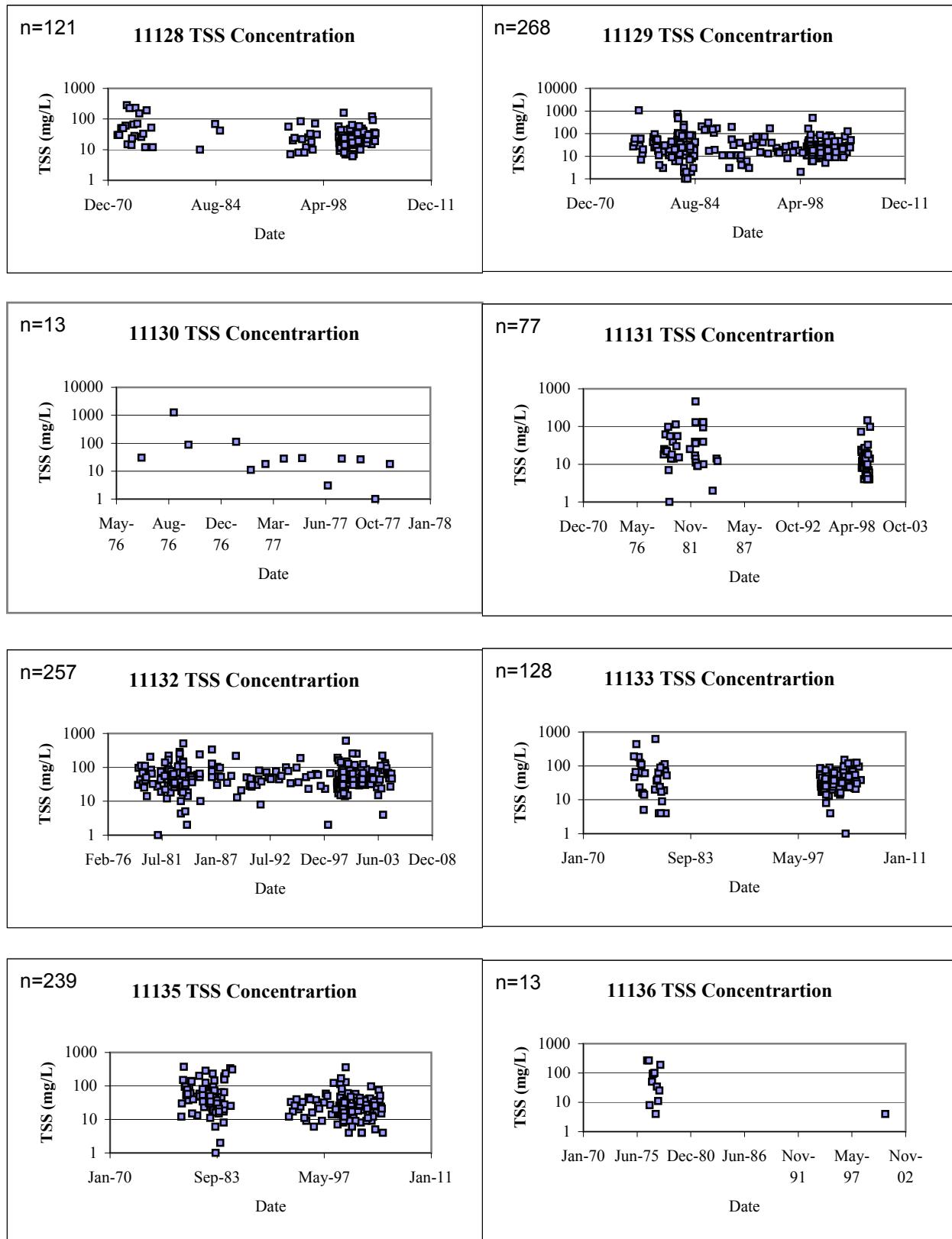


Figure 2.8b TSS Data in 1007 Non-tidal Segments

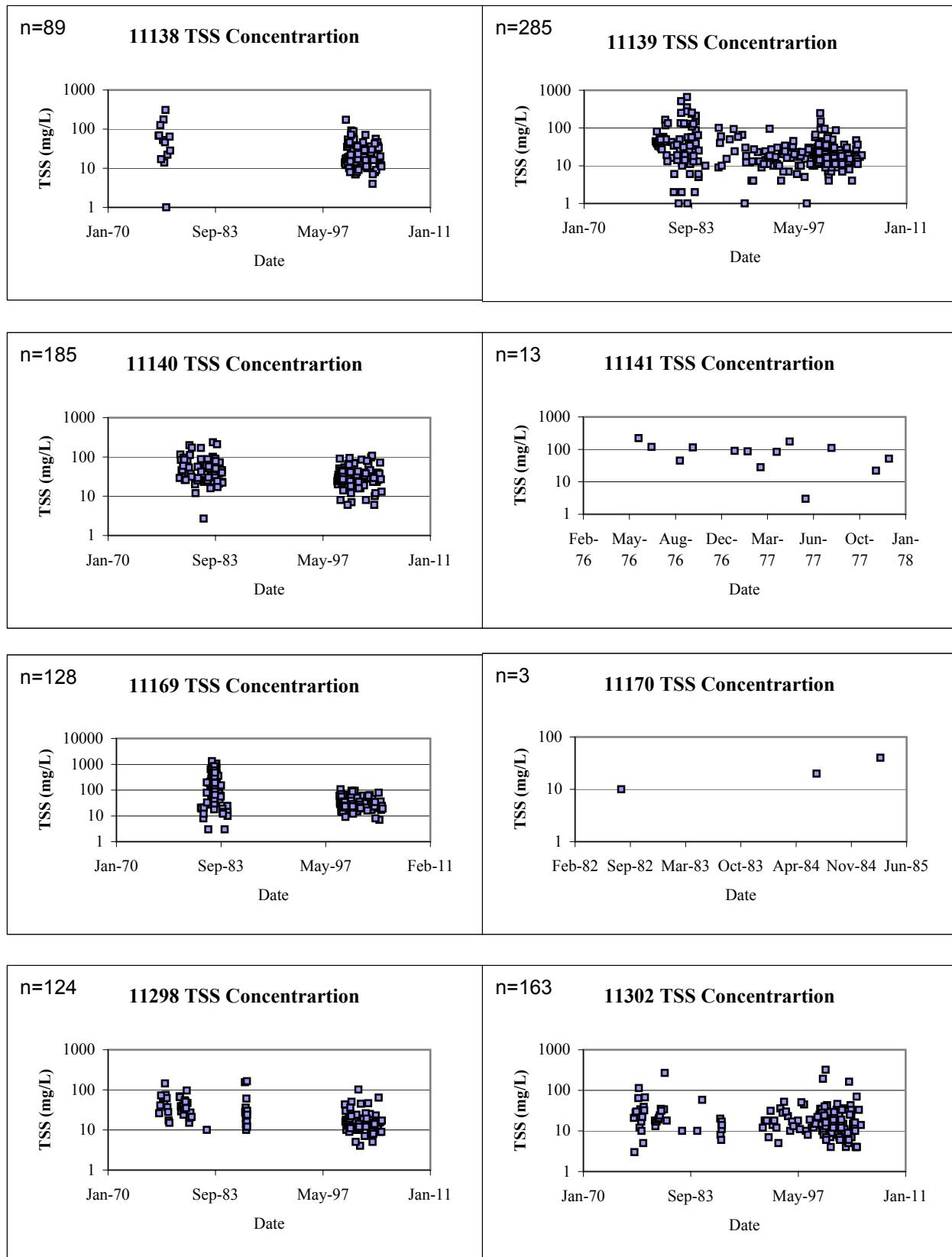


Figure 2.8b TSS Data in 1007 Non-tidal Segments - Cont'd

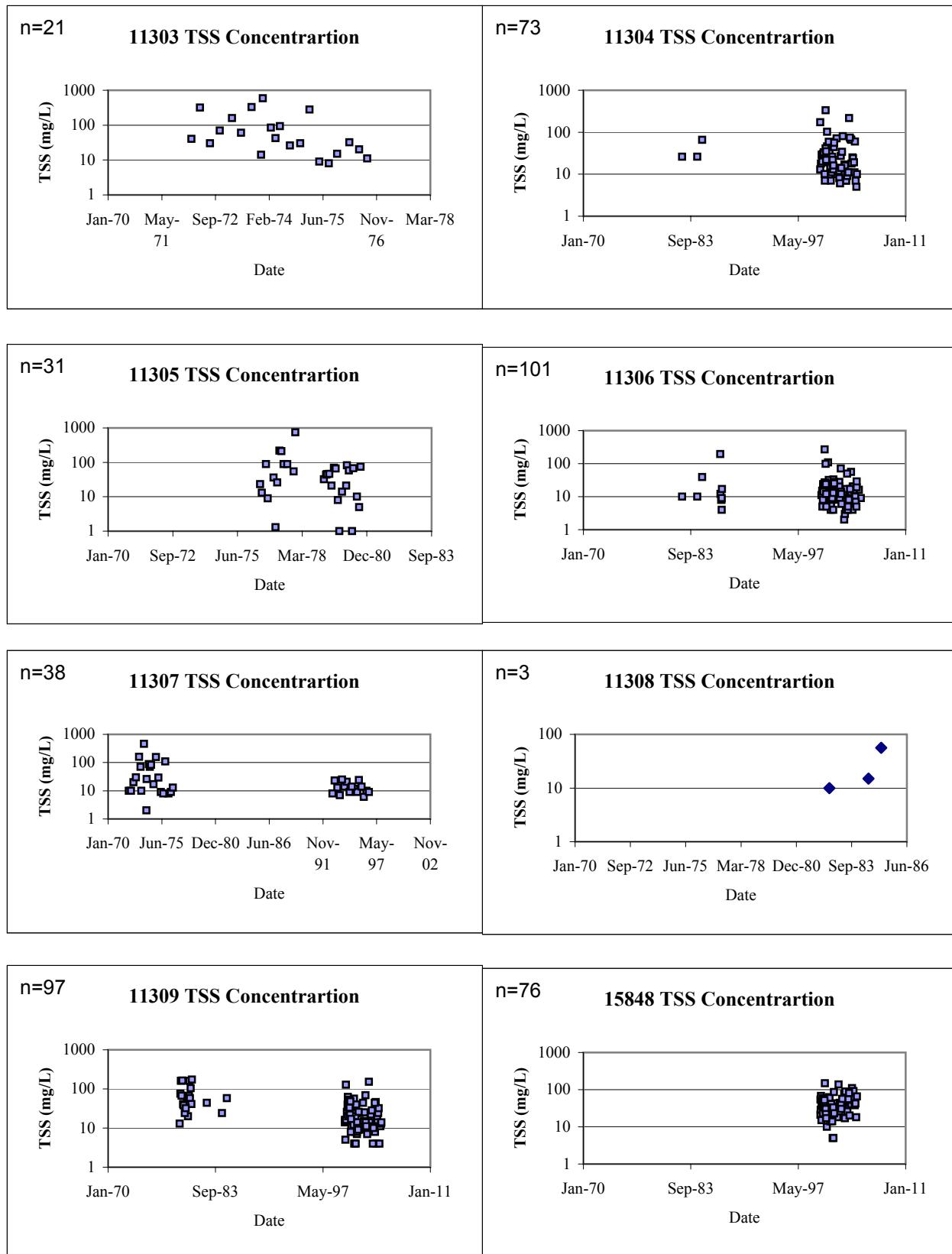


Figure 2.8b TSS Data in 1007 Non-tidal Segments - Cont'd

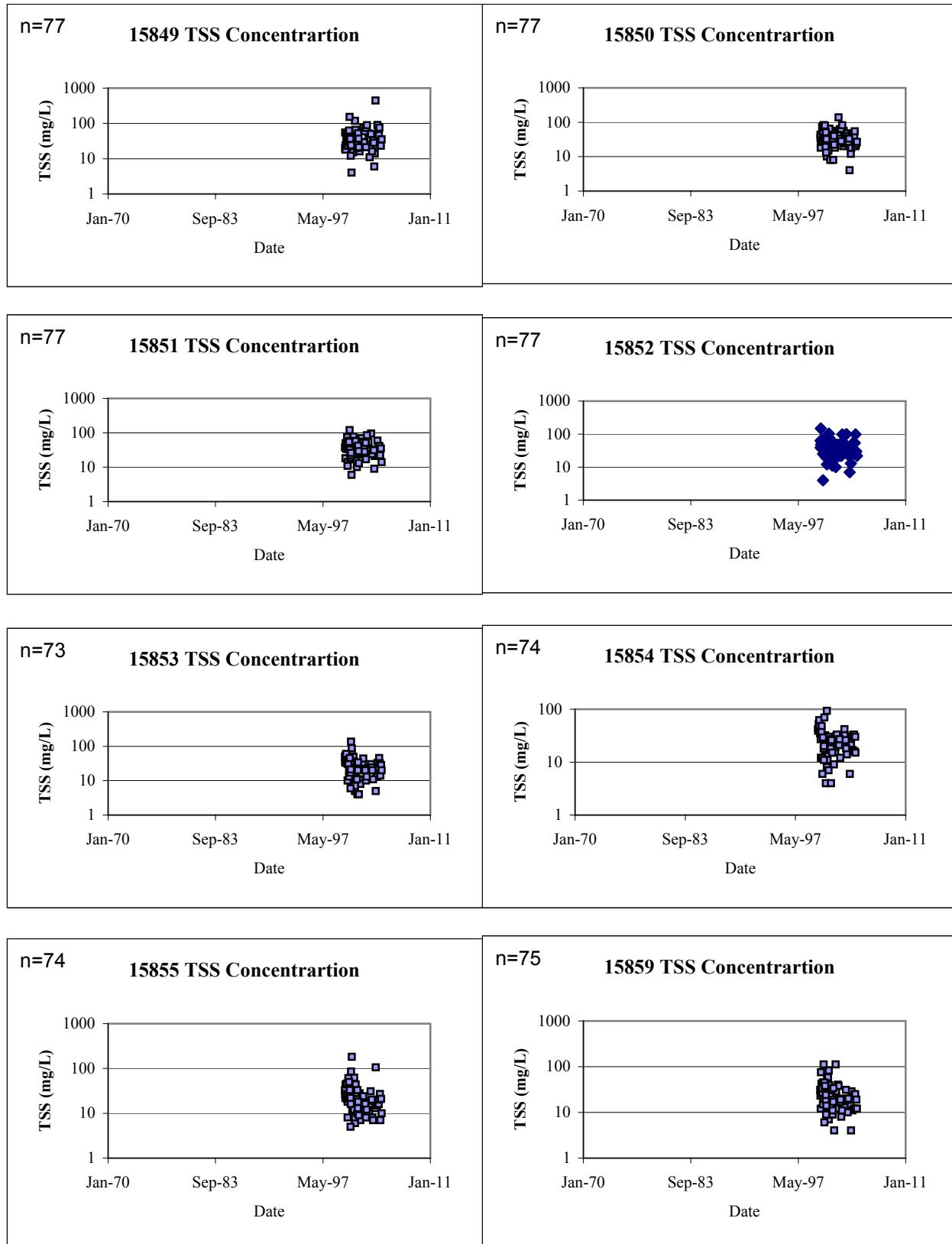


Figure 2.8b TSS Data in 1007 Non-tidal Segments - Cont'd

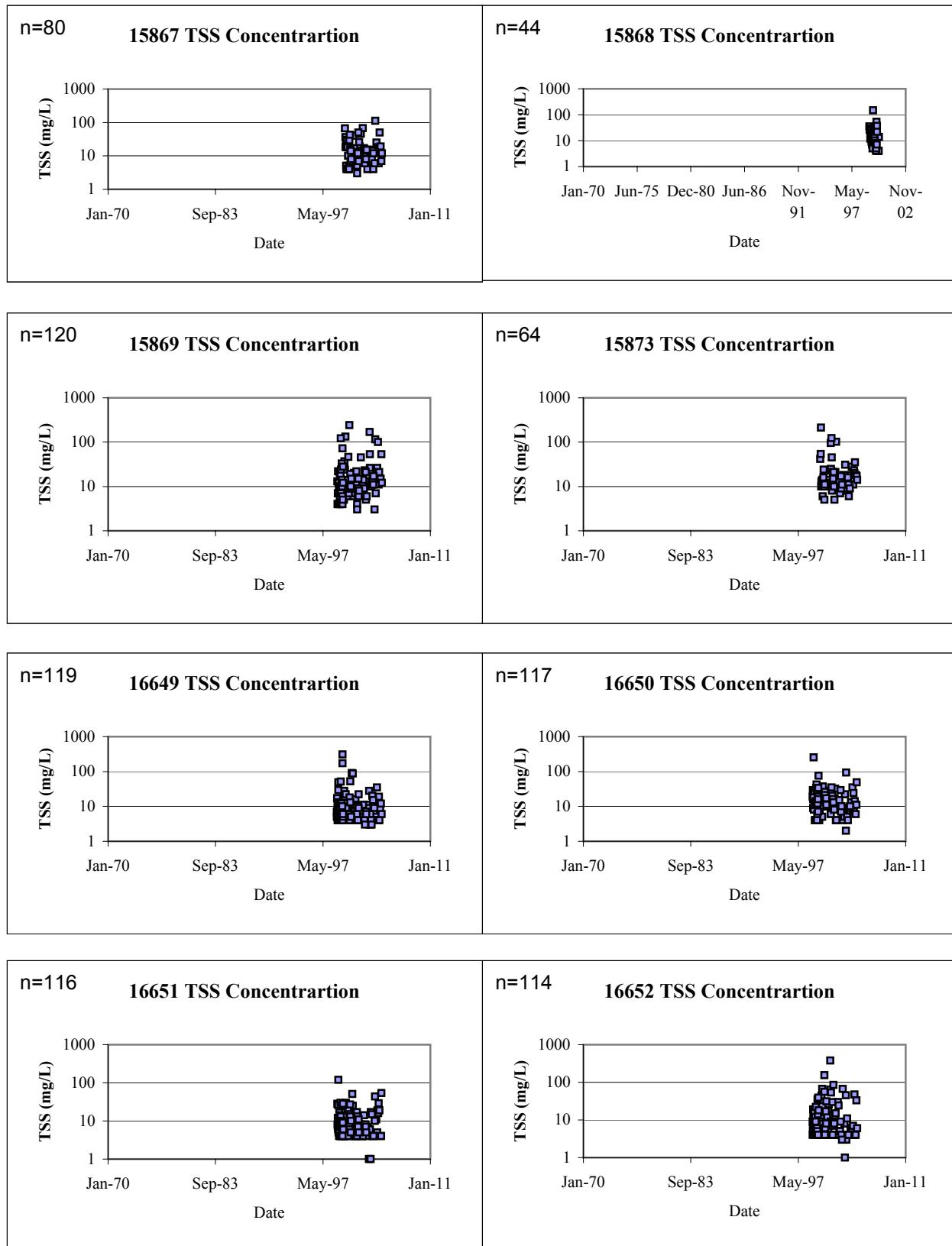


Figure 2.8b TSS Data in 1007 Non-tidal Segments - Cont'd

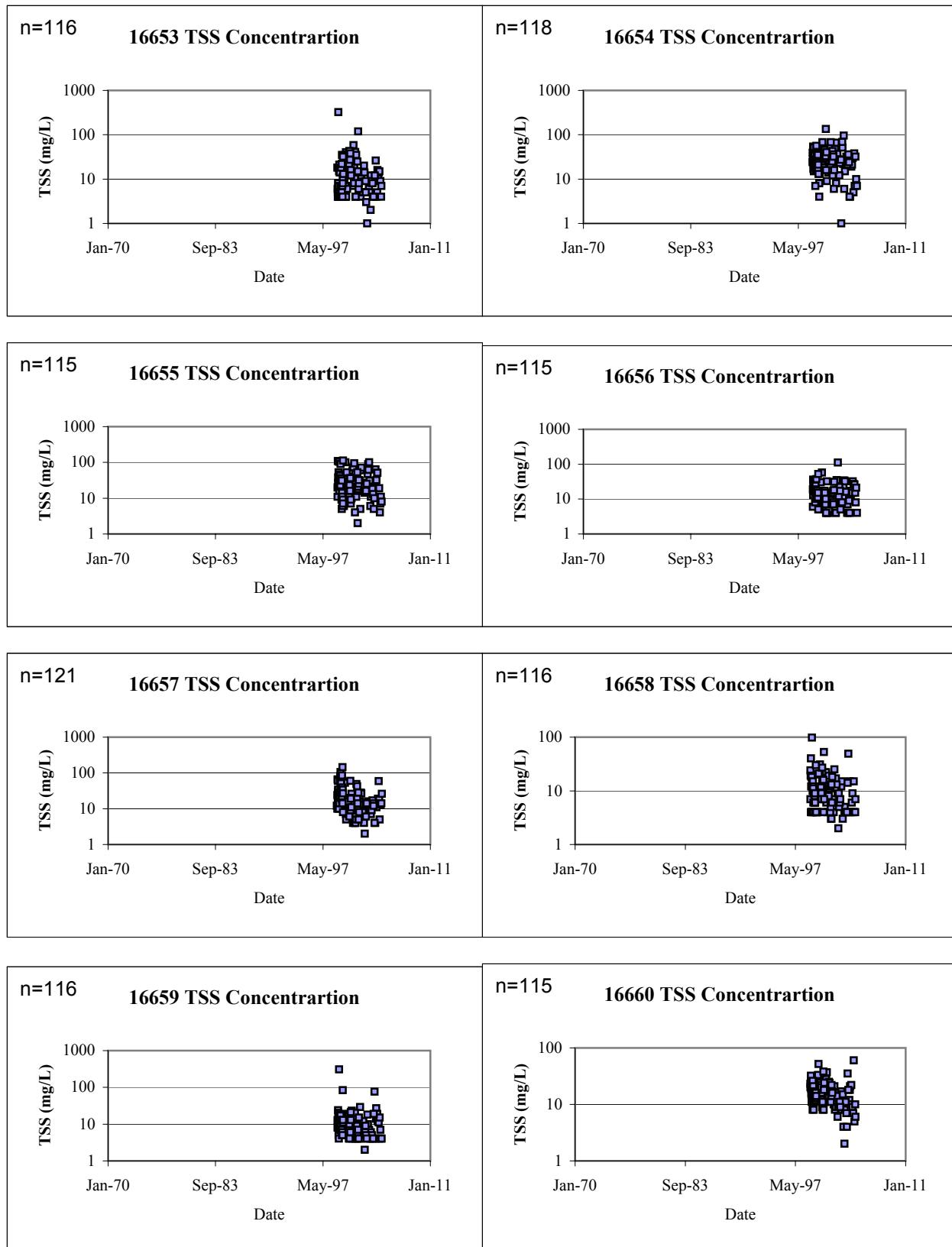


Figure 2.8b TSS Data in 1007 Non-tidal Segments - Cont'd

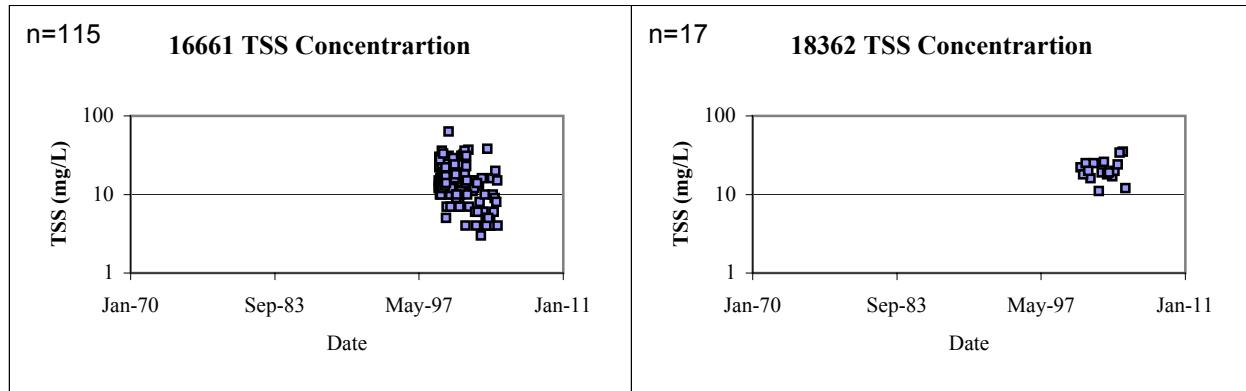


Figure 2.8b TSS Data in 1007 Non-tidal Segments - Cont'd

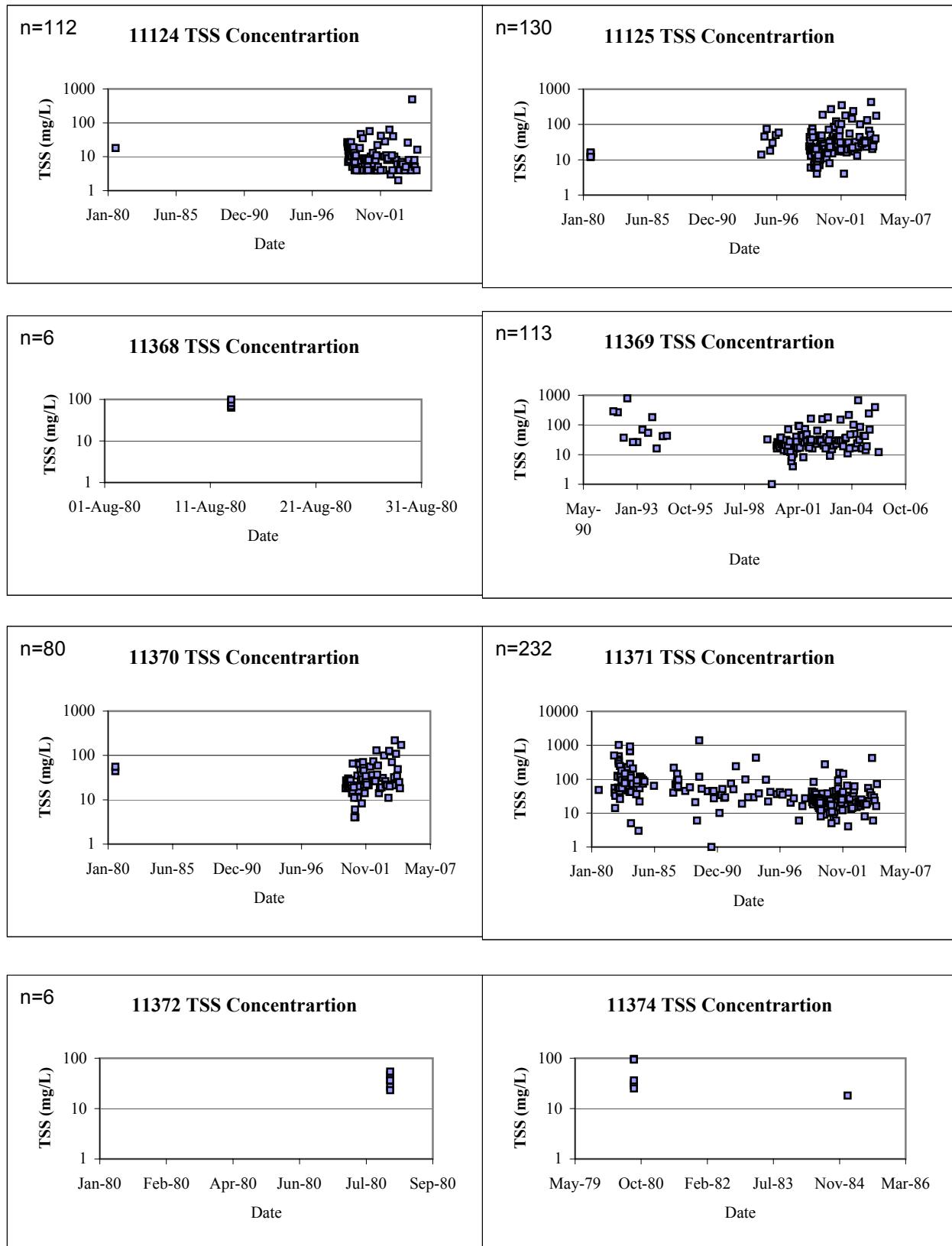


Figure 2.8c TSS Data in Segment 1016

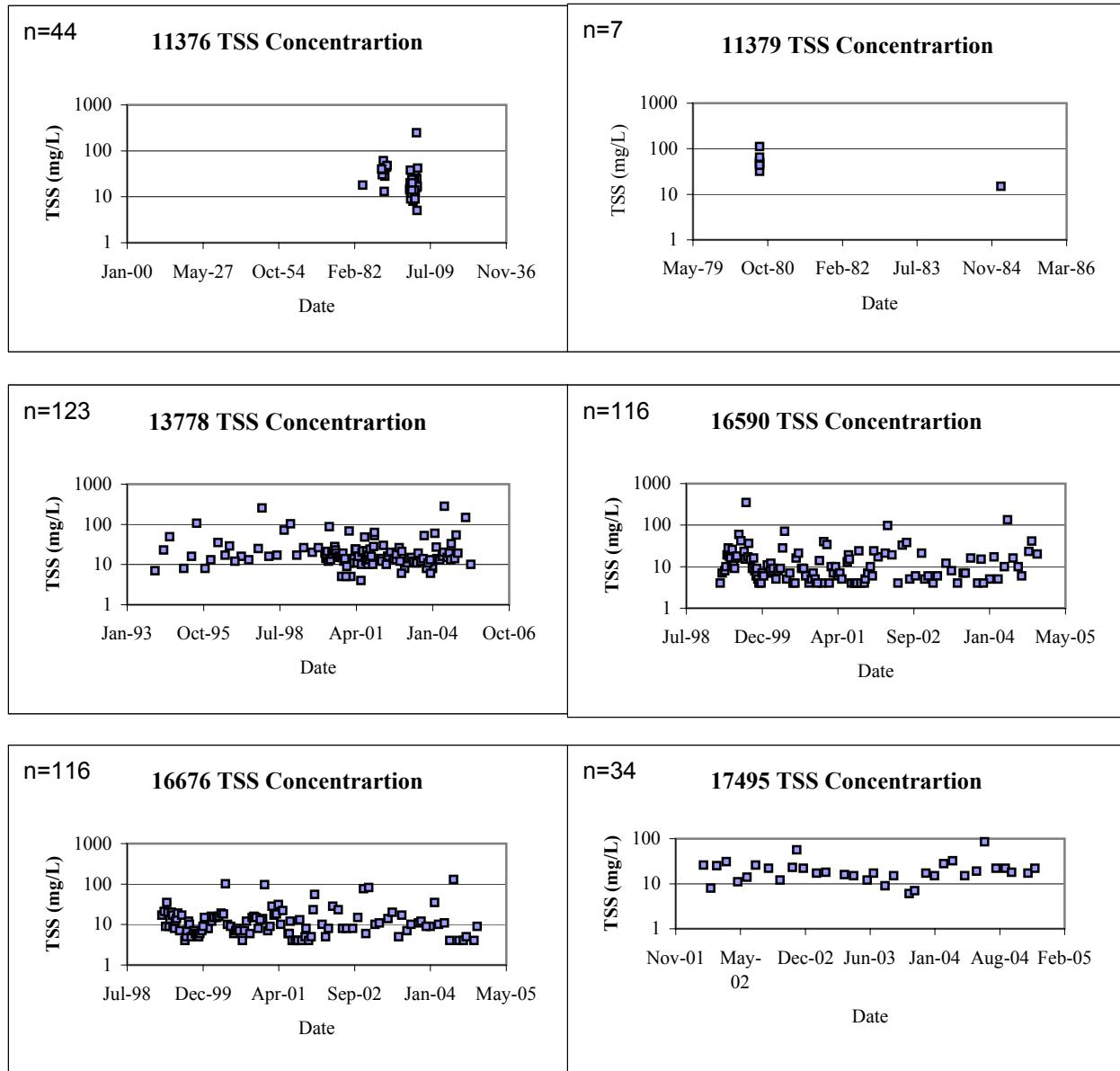


Figure 2.8c TSS Data in Segment 1016 - Cont'd

Table 2.5 Summary of Data Availability and Needs

Segment	Description	No. Bacteria Stations	No Stations w/ Sufficient	No. Stations w/Insufficient	No. Flow Gages	Flow Period		Data Needs
						From	To	
1006D	Halls Bayou below US 59	4	4	0				
1006E	Halls Bayou above US 59	2	2	0	1	10/01/52	09/30/04	
1006F	Big Gulch Above Tidal	2	1	1				E. coli from additional station
1006H	Spring Gully Above Tidal	1	1	0				E. coli from additional station
1006I	Unnamed Tributary of Halls Bayou	2	2	0				
1006J	Unnamed Tributary of Halls Bayou	1	1	0				
1007B	Brays Bayou Above Tidal	14	13	1	2	06/01/36	09/30/04	
1007C	Keegans Bayou above tidal	1	1	0	1	09/01/64	09/30/81	E.coli and Flow Monitoring. Additional station
1007D	Sims Bayou Above Tidal	5	4	1	1	10/01/52	09/01/01	Flow
1007E	Willow Waterhole Bayou Above Tidal	1	1	0				
1007F	Berry Bayou Above Tidal	1	1	0	1	05/01/64	09/30/01	E. coli from additional station. Flow
1007G	Kuhlman Gully Above Tidal	1	1	0				
1007H	Pine Gully Above Tidal	1	1	0				
1007I	Plum Creek Above Tidal	1	1	0				
1007K	Country Club Bayou	2	2	0				
1007L	Unnamed Non-Tidal Tributary of Brays Bayou	1	1	0				
1007M	Unnamed Non-Tidal Tributary of Hunting Bayou	1	1	0				
1007N	Unnamed Non-Tidal Tributary of Sims Bayou	1	1	0				
1007O	Unnamed Non-Tidal Tributary of Buffalo Bayou	2	1	1				
1007P	Brays Bayou Above Tidal	0	0	0				E. coli
1007Q	Sims Bayou Above Tidal	4	2	2	1	09/01/64	09/30/04	
1007R	Hunting Bayou Above Tidal	14	6	8	1	05/01/64	09/30/04	
1016	Greens Bayou Above Tidal	14	6	8	4	10/01/52	09/30/04	
1016A	Garners Bayou	2	2	0	1	02/25/86	09/30/04	E. coli from additional station
1016B	Unnamed Tributary of Greens Bayou	1	1	0				
1016C	Unnamed Tributary of Greens Bayou	1	1	0				
1016D	Unnamed Tributary of Greens Bayou	1	1	0				
<i>Total</i>		81	59	22	13			

^a Stations with more than 20 data points and data up to 2004^b Stations with fewer than 20 data points and/or data older than 2004

CHAPTER 3

PROPOSED SAMPLING AND

DATA COLLECTION ACTIVITIES

After review of the existing historical data on the segments and watersheds included in this TMDL study and identification of data gaps and needs, UH developed a proposed action plan for the remainder of the fiscal year in support of the development of total maximum daily loads (TMDLs) for Indicator Bacteria in the Houston Metropolitan Area. Two main activities will be undertaken during FY2006: 1) data gathering including field reconnaissance and survey, and 2) preliminary sampling.

The goal of the data gathering activity is two-fold: (i) to complete an assessment of the fecal pathogen and *E. coli* levels and trends in the project watersheds based on historical data, and (ii) to prepare an inventory of major sources and fate and transport of *E. coli* and fecal contamination in the target waterbodies based on historical data. Existing land use, hydrologic and MS4 data for the project watersheds will be compiled as well as results from previous field bacteria surveys (e.g. Greens Bayou dry weather storm sewer sampling). A database of potential bacteria sources in the TMDL area will be compiled including WWTP permits (location, flows, fecal data, etc), overflows and bypasses reported by the City of Houston, stormwater outfalls, septic tanks, and wildlife population studies.

The goal of the sampling effort is to provide sufficient data for the development of Load Duration Curves (LDC) to support TMDL development. During FY2006, an Intensive Survey to obtain flow/EC data will be conducted. Twenty-one tentative

locations (Table 3.1 and Figure 3.1) have been identified including the mouth of all study segments, and selected locations with historically high EC concentrations. For the intensive survey, samples will be collected during three different events to cover different flow conditions. For each sampling event, each location will be sampled 5-6 times for a total of 15-18 data points.

The proposed plan is currently being reviewed by TCEQ. Once the plan is approved, UH will initiate the development of a Quality Assurance Project Plan (QAPP) for the sampling activities included in the plan.

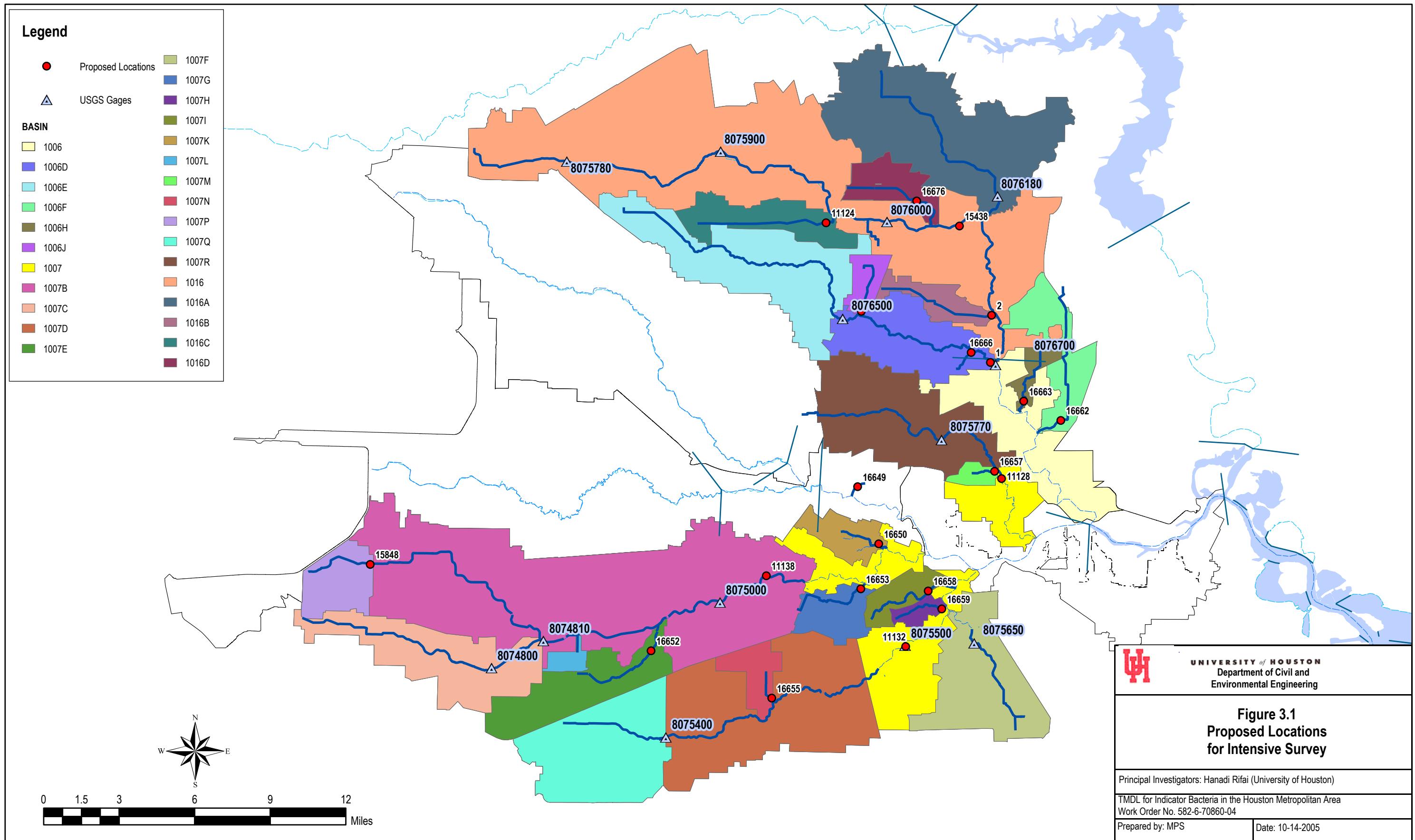
Table 3.1 Proposed Locations for Intensive Survey

Segment	Name	Station	Reason for Inclusion	Flow regime	Historical Bacteria Data		2005 Sampling	
					Indicator ^c	Geomean (MPN/dL)	Indicator ^c	Concentration (MPN/dL)
1102B	Marys Creek	16803	Beginning of Segment	Non-tidal	EC	40	e	e
1102B	Marys Creek	17915	Middle segment after 2 major WWTPs	Non-tidal	d	d	e	e
1102B	Marys Creek	16473	End of segment	Non-tidal	EC	354	EC	150
1102A	Cowart Creek	16678	Middle segment after tributary	Non-tidal	d	d	EC	675
1102A	Cowart Creek	11425	End of segment	Non-tidal	FC	628	EC	257
	Hickory Slough	17068	To calculate load of tributary to 1102	Non-tidal	EC	147	EC	39
1102	Clear Creek Above Tidal	17079	After major WWTP, change in landuse	Non-tidal	EC	165	EC	95
1102	Clear Creek Above Tidal	11452	USGS location	Non-tidal	EC	152	EC	149
1102	Clear Creek Above Tidal	11450	USGS location, before Marys Creek discharge	Non-tidal	EC	385	EC	519
1102	Clear Creek Above Tidal	11453	Highest historic geomean for segment 1102	Non-tidal	FC	439	e	e
	Turkey Creek	F1 ^a	To calculate load from Turkey Creek to Segment 1102	Non-tidal	d	d	e	e
1101B	Chigger Creek	16472	End of segment	Non-tidal	EC	169	e	e
1101B	Chigger Creek	16493	Highest historic geomean for segment 1101B	Non-tidal	EC	417	EC	500
	Magnolia Creek	16611	To calculate load from Magnolia Creek to Segment 1101	Tidal	EC	238	NT	2110
	Unnamed tributary to Clear Creek	TBD-03 ^b	To calculate load from Unnamed tributary to segment 1101	Tidal	d	d	NT	5457
2425C	Robinsons Bayou	F2 ^a	End of segment	Tidal	d	d	e	e
2425C	Robinsons Bayou	16486	Middle of segment	Tidal	NT	684	NT	2322
1101	Clear Creek Tidal	11448	Beginning of segment, after Cowart Creek discharge, highest historical geomean	Tidal	NT	244	NT	104
1101	Clear Creek Tidal	16576	After Chigger Creek and major WWTP discharge	Tidal	NT	81	NT	40
1101	Clear Creek Tidal	16985	End of segment, major WWTP discharge	Tidal	NT	85	NT	85

Optional

^a New station^b Station sampled in 2005, SLOC request in process^c EC = *E. coli*; EN = Enterococci; FC= Fecal coliform^d No historical bacteria data area available for this station^e This site was not sampled in 2005

Three one-week sampling events will be undertaken. During each event all the locations will be sampled 5-6 times for flow, EC/EN, TSS, and field parameters. For tidal stations sondes will be deployed to relate flow to tide height.



CHAPTER 4

SUMMARY AND FUTURE ACTIVITIES

4.1 SUMMARY

During the first quarter of this TMDL project, a review of available data for the 27 study segments and associated watersheds was completed. The data gathered included precipitation, stream flow, TSS, and fecal indicator (FC and EC).

While the flow network is limited, an extensive network of bacteria stations is available for the TMDL segments. It is noted, however, that the fecal indicator data are generally not associated with flow measurements, which makes it difficult to calculate load duration curves in support of TMDL development. Therefore, an intensive survey is proposed for 21 locations to collect between 15-18 bacteria/flow data pairs during three independent sampling events.

An evaluation of EC data showed that the not-to-exceed standard of 394 MPN/dL is exceeded in more than 80% of the samples. Time series of EC data showed that, for most stations, concentrations are not decreasing over time. This trend analysis, however, is preliminary. Further statistical analyses are being conducted to establish the existence of temporal trends (if any).

Longitudinal profiles of EC geometric mean concentrations along the major tributaries included in this study showed little to no trend with distance. This lack of spatial trends was confirmed with linear regression analyses.

4.2 PLANNED ACTIVITIES FOR THE SECOND QUARTER OF THE PROJECT TIME FRAME

During the period December 1, 2005 to February 28, 2006, the project team will be focusing on the following activities (numbered as they appear in the Work Plan for WO# 582-6-70860-04):

Task 3.3 – Development of the project strategy for the Houston Metropolitan Indicator Bacteria TMDL project.

Subtask 3.4.1 - Complete the assessment of the fecal pathogen and *E. coli* levels and trends in the project watersheds based on historical data.

Subtask 3.4.2 - Prepare an inventory of major sources and fate and transport of *E. coli* and fecal contamination in the target waterbodies based on historical data.

In addition to the activities underlined in the approved sampling plan, the project team will prepare a QAPP for the proposed sampling activities once the approval from TCEQ is received.